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Notice of Meeting of Texas Gas and Electric Men.

AUSTIN, TEXAS, April 20th, 1895.

To the Managers, Superintendents and other Officers of the Gas and Electric Companies of Texas: Gentlemen—In response to a circular letter sent out some weeks ago relative to an organization of the Texas gas and electric men, on lines similar to the "Ohio," "Western," "American," and other well known organizations of lighting men, the gentlemen mentioned below have expressed their approval of the move, and join in a call for a meeting. Several have written at length expressing the most hearty approval of the move, and urging that each officer of a gas or electric company, and especially those connected with the smaller companies, be invited to attend and take part in the preliminary as well as permanent organization.

All interested in the gas or electric business are cordially invited to attend our meeting, and as it will probably be deemed wise to arrange for associate members, those wishing to do so may join as associate members.

The meeting will be a strictly business affair—no banquets, excursions, or "blow-outs" of any description; but we all expect to have a thoroughly enjoyable time, nevertheless.

Membership fee will be small, annual dues not burdensome, and expenses must be kept at a minimum.

Arrange to be with us at the first meeting at Houston, Texas, May 22, 10 A.M., "Mason's Hall," Mason block, corner Main street and Rusk avenue. Or, if you can not be present, send in your application for membership, that we may know that you wish to be identified with us.

Many favored Houston and May as the place and time for meeting, and the very low excursion rates, on account of Confederate Veterans' Re-Union (one fare for round trip, with maximum of $5 within the State), makes it especially desirable to meet there.

[Here follow the names of the signers to the number of 20, representing as many lighting companies of Texas.]

[OFFICIAL NOTICE.]

Eighteenth Annual Meeting, Western Gas Association.

OFFICE OF WESTERN GAS ASSOCIATION,
NEW ALBANY, IND., May 1, 1895.

To the Members of the Western Gas Association: The 18th Annual Meeting of the Western Gas Association will be held at Pittsburgh, May 15th, 16th and 17th, 1895, and will be called to order by the President, Mr. I. C. Baxter, at 10 A.M., Wednesday, May 15th.

The Monongahela House has been selected as the headquarters for the members, and the meeting of the Association will be held in a suitable room contained therein. A rate of $3 per day has been obtained for those attending the meeting.

The Executive Committee met at Pittsburgh, last February, and selected the following papers to be presented to the Association:

"Metal Tanks for Gasholders," by Mr. Alten S. Miller, Long Island City, N. Y.

"The Advantage of the Metric System for All Calculations," by Mr. Geo. H. Harper, Altoona, Pa.

"Acetylene," by Mr. F. L. Slocum, Pittsburgh, Pa.

"Recuperative Furnaces, as Applied to Bench Firing: Their Operation and Results," by Mr. J. A. Faux, Pittsburgh, Pa.

"Some Experience with Foul Gas in Holder," by Mr. Jas. T. Lynn, Detroit, Mich.

"Ammoniacal Liquor, with Special Reference to the Universal Saving of Same, by Gas Companies," by Mr. Geo. Osius, Detroit, Mich.

"Natural Gas as a Pioneer for Artificial Fuel Gas," by Mr. Donald McDonald, Louisville, Ky.

"Handling and Storage of Oil by Gas Companies," by Mr. D. J. Collins, Chicago, Ills.

"Best Method of Introducing Gas Engines," by Mr. C. B. Case, Milwaukee, Wis.

"Incandescent Gas Lighting," by Mr. S. M. Highlands, Clinton, Ia.

"Wrinkle Department," edited by Mr. Geo. T. Thompson, St. Louis, Mo.

The Central Traffic Association, Trunk Line, Boston Passenger Committee and Southern Passenger Association have granted rates of 1⅓ fare for the round trip, conditional on 100 certificates being presented to the Secretary for indorsement. The territory of the Central Traffic Association is bounded on the east by Pittsburgh, Salamanca, Buffalo and Toronto; on the north by the line of, and including points on the Grand Trunk Railway from, Toronto to Port Huron; thence via Lakes Huron and Michigan, to the north line of Cook county, Ills.; on the west by the west line of Cook county and the Illinois and Mississippi rivers to Cairo, including Burlington, Keokuk, Quincy, Hannibal and St. Louis; and on the south by the Ohio river, but including points on either side of that river.

The Trunk Line territory is as follows: From Niagara Falls, Buffalo and Salamanca, N. Y., Pittsburgh, Pa., Bellaire, O., Wheeling, Parkersburg and Charleston, W. Va., and points east thereof, except in New England. The names of the roads making the reduction are as follows: Addison & Pennsylvania; Allegheny Valley; Baltimore & Ohio; Baltimore & Potomac; Buffalo, Rochester & Pittsburgh; Camden & Atlantic; Central, of New Jersey; Chesapeake & Ohio; Cumberland Valley; Delaware & Hudson Canal Co.; Delaware, Lackawanna & Western; Elmira, Cortland & Northern; Fall Brook Coal Co.; Fonda, Johnstown & Gloversville; Lehigh Valley; New York Central & Hudson River—Harlem division excepted; New York, Lake Erie & Western; New York, Ontario & Western; New York, Philadelphia & Norfolk; New York, Susquehanna & Western; Northern Central; Pennsylvania; Philadelphia & Erie; Philadelphia & Reading; Philadelphia, Wilmington & Baltimore; Rome, Watertown & Ogdensburg; Western New York & Pennsylvania; West Jersey; West Shore; Wilmington & Northern.

The Boston Passenger Committee territory is from points on the following roads: Boston & Albany; Boston & Maine; Central Vermont; Concord & Montreal; Fitchburg; Maine Central; New York & New England; New York, New Haven & Hartford; Portland & Rochester.

The Southern Passenger Association is composed of the following Companies: Alabama Great Southern; Alabama Midland; Atlantic Coast Line; Atlantic & Florida; Atlantic & West Point; Charleston & Savannah; Central Railroad, of Georgia; Cincinnati, New Orleans & Texas Pacific; East Tennessee, Virginia & Georgia; Georgia Railroad; Georgia Pacific; Georgia Southern & Florida; Jacksonville, St. Augustine & Indian River; Knoxville, Cumberland Gap & Louisville; Louisville & Nashville; Marietta & North Georgia; Memphis & Charleston; Morristown & Cumberland Gap; Nashville, Chattanooga & St. Louis; Pennsylvania; Port Royal & Augusta; Richmond, Fredericksburg & Potomac; Savannah, Florida & Western; South Carolina; Southern Railway Company; Western & Atlantic.

All persons attending the meeting will purchase a first class ticket at starting point, paying full fare for same, obtaining from agent a certificate stating that the person whose signature appears on same has purchased at full tariff fare one first-class ticket to Pittsburgh, which certificate, after it has been signed by the Secretary of the Western Gas Association, and a representative of the above Passenger Associations, who will be in attendance at our meeting, will entitle the holder thereof to one-third fare returning home. This reduced rate privilege extends also to wives of delegates.

All persons availing themselves of the reduced rates will apply to agent 30 minutes before the departure of train. Tickets in accordance with above arrangement can be purchased on and after Saturday, May 11th, and are good, for return trip, on or before Tuesday, May 21st. All agents do not have a supply of certificates, but they may be obtained by request, if notification is made in time. Those parties outside the territory embraced by above four Passenger Associations can obtain reduced rates of 1⅓ fare for the round trip by purchasing tickets to nearest point within above territory, and from there purchasing a ticket to Pittsburgh. No refund of fare can be expected because of failure of the parties to obtain certificates.

There will be an exhibit of gas appliances, to which all manufacturers are invited to contribute. Any information, as to space and place of exhibit, can be obtained from Mr. F. L. Slocum, President of the Gas Engineering Company, of Pittsburgh. It is important that exhibitors apply for space at once and complete their arrangements.

This year we meet in new territory, adjacent to which are many Companies whose officials are not members of the Western Gas Association. We hope that many will embrace this opportunity to become members. The Secretary will be pleased to give those desiring to become members any information wanted, and to mail them copies of the Constitution and By-laws.

The Question Box is now ready to receive inquiries, and those obtained before the meeting will be published, so that all may come prepared to answer them. The Secretary will be pleased to have a number of questions sent him. A cordial invitation is extended to members of other Associations to attend our meeting, and it is hoped that many will avail themselves of the opportunity to be present.

The meeting of the Board of Directors will be held Tuesday, May 14, at 10 A.M., for the transaction of such business as may regularly come before it. The Directory is composed of the following gentlemen: E. H. Jenkins, J. W. Stratton, W. M. Eaton, James Forbes, Wm. McDonald, Geo. T. Thompson, Irvin Butterworth, Robert Young.

The Committee of Arrangements announce a river excursion for Friday, May 17th, to Homestead. The ladies who may be present will be well cared for; everything will be done to make their stay in Pittsburgh pleasant and enjoyable.

Assurance has been given by the Managers of the Monongahela House that they will be able to care for all who may attend; but it is always advisable to secure rooms in advance. Should any not be able to find at the Monongahela House just such accommodations as might be desired, the Duquesne and other good hotels near by are open to receive guests. It will add much to the success of the meeting, however, if all are housed under one roof.

The following Questions have been received: 1. Does the candle power of the gas affect the size of flames, and in what proportion, pressure and burner being the same? 2. What is the best way to prevent the sweating of show windows of gas lighted storerooms in winter time? 3. In cases of introducing gas into houses which have not been piped, has any attempt been made to obviate the necessity of tearing up the floors or of disfiguring ceiling, first, by using a special kind of pipe; or, second, by inclosing common pipe in suitable moulding? 4. Has anyone had experience heating an office or house with furnace in which artificial gas was used as fuel? 5. Does the Welsbach burner produce as much heat, light for light, as an ordinary batwing burner?

JAS. W. DUNBAR, Secretary.

BRIEFLY TOLD.

THIS WEEK AT PITTSBURGH.—The 18th annual convention of the Western Gas Association, to be brought off at Pittsburgh this week, promises to be of the kind which the Association usually enjoys—an assemblage that results in profit to those who by their presence compose it. Secretary Dunbar has worked with fidelity and skill in arranging for the preparatory details, and having so labored, no other eventuality than success could ensue. This is all the more meritorious when one remembers that back of his efforts lies the fact that it is his first year's service in the performance of his secretarial duties. Look over the programme in what spirit one will, no other conclusion can be reached than that the Western is bound to maintain its record for having good, serviceable and effective meetings. One odd thing in connection with the naming of the Monongahela House as headquarters is traceable to that which cannot be called a coincidence; for there is to be a Presbyterian assembly in Pittsburgh during some of the time at least of the Association's stay, and the Presbyterians also are to be domiciled at the Monongahela. However, we do not mean to say that the Presbyterians will not be fully welcome. The arrangement of the programme this year does not include a banquet, and the main feature of the outing will be a trip over the Monongahela river to the famous steel and iron city of Homestead. The local committee of arrangements have made special preparation for the entertainment of the gentler sex who will honor the Association by accepting its invitation; and, altogether, as remarked before, it is quite out of the question to predict other than success for the Western's 18th reunion. Those who will be present should carefully study the Secretary's references to the manner of obtaining the one and one-third fare rate for the round trip, since in many instances this concession will amount to a considerable saving in money, and it is necessary in order that any may obtain it that 100 certificates should be made out.

THE PITTSBURGH MEETING OF THE COUNCIL OF THE AMERICAN ASSOCIATION.—In connection with our reference to the meeting of the Western Association it might not be amiss to state that a meeting of the Council of the American Gas Light Association is called for the evening of the 14th inst., at the Monongahela House. Secretary Slater will be on hand on the afternoon of that date at an hour sufficiently early to inform the Councilmen when and where (so far as a room in the Monongahela House is concerned) the session will be held. It is hoped that the Councilmen will all be present, for very many important matters are on the docket.

DEATH OF MR. A. B. MAGUIRE.—We regret to have to report the death of Mr. A. B. Maguire, Secretary and Manager of the Urbana (O.) Gas Light and Coke Company, whose demise occurred very suddenly, in Urbana, on the night of April 18th. Deceased was born in Port Jervis, N. Y., in 1870, and was the son of Thomas Maguire, who for years acted as Superintendent of the Port Jervis Company, and who is now Superintendent of the Honesdale (Pa.) Company. Young Maguire, having graduated from the Port Jervis High School, served under his father for some time at the Port Jervis works, acquiring a knowledge of the business of gas manufacture, and eventually received appointment to the post where death found him. He was an active member of the Ohio Gas Light Association, and was an estimable and promising member of the fraternity. The funeral services were held in Port Jervis.

A Graphic Discourse on Some of the Components of Illuminating Gas.

[By Dr. A. W. Wilkinson, before the April meeting of the Society of Gas Lighting.]

You are aware that the gas we call illuminating gas is a mixture of several gases. Thinking that it may be interesting to see these gases by themselves, I have borrowed the necessary apparatus from the laboratory of Dr. Doremus, to isolate them; and the Doctor has kindly consented to be present and assist in the experiments.

The first gas we have to present is hydrogen. It forms from 45 to 50 per cent. of coal gas, and from 30 to 40 per cent. of water gas. It is the lightest of all known bodies, 100 cubic inches weighing but 2.14 grains. It forms one-ninth of the water of the earth by weight, and enters into the composition of both vegetable and animal tissues. It is not poisonous to breathe, but would kill by excluding oxygen. It is usually made by decomposing water, yet there are various other ways of isolating it. It is but slightly soluble in water—3 or 4 per cent. only. It burns, as you see, with hardly any light; in fact, when pure you can hardly see it in the daylight. The product of combustion is water. If we hold a piece of cold iron in the flame you see how quickly the moisture collects, and soon you see it dripping from the iron.

The second gas we will call your attention to is known as light carbureted hydrogen, composition CH_4. One hundred cubic inches of this gas weigh 17.12 grains. It forms from 40 to 50 per cent. of all coal gas, and from 5 to 10 per cent. of water gas. It is frequently spoken of as marsh gas for the reason that it is found in abundance in marshy regions. It is the natural gas that is found in so many regions in the West. It burns with a very slight amount of illumination, the products of combustion being carbonic acid and vapor of water. It is not poisonous, although, like hydrogen, it would kill by excluding oxygen.

The third gas we call your attention to is known as carbonic oxide, composition CO. One hundred cubic inches weigh 30 grains. This gas you are familiar with from seeing it burn over freshly made hard coal fires. It burns with a pale blue flame. The product of combustion is carbonic acid. This gas is decidedly poisonous. It not only poisons by excluding oxygen, but it poisons directly. The action of carbonic oxide on the blood corpuscles is such that they are killed, and recovery from inhaling carbonic oxide is exceedingly rare. It exists in from 5 to 10 per cent. in coal gas, and from 30 to 40 per cent. in water gas.

These three gases form the great bulk of what is known as illuminating gas, although, as you see, they themselves contain but a very slight amount of illumination.

The first gas that I shall call your attention to that is capable of giving illumination is known as olefiant gas. This name is given to it from the fact that with chlorine it readily forms an oil. It exists in coal gas from 3 to 5 per cent. One hundred cubic inches of it weigh 30 grains. It burns with a beautiful, clear, white light. The products of combustion are carbonic acid and vapor of water. We have in water gas a gas corresponding somewhat to olefiant gas, known as oil gas. The composition is C_3H_3. It burns with a beautiful white light, not as brilliant, as you see, as olefiant gas, yet it is the gas that adds the illumination to water gas, forming as it does from 10 to 15 per cent.

The next gas I call your attention to is known as acetylene—composition, C_2H_2. This is an exceedingly soluble gas. It exists in coal gas in from ½ to 3 per cent., depending upon the nature of the coal from which the gas is made; the richer cannel coals making a larger and higher per cent. of this most desirable of all gases for illumination. Until within a very short time we were unable to produce any great amount of acetylene in our illuminating gas. As a bye-product in the making of aluminum we have a substance known as carbide of calcium, which, when thrown into water, liberates acetylene. The gas itself burns with an intense white light, giving off clouds of carbon; yet, when properly diluted with coal gas, it gives the most brilliant gas we have yet been able to produce. It is claimed that it has a candle power of from 200 to 250; and that from 3 to 5 per cent. of it will enrich coal gas from 14 to 22 or 23 candles. If it is possible that this substance (the carbide of calcium) can be produced at a commercial rate that will enable gas companies to use it as an enricher, it will prove one of the most desirable articles that has been presented to the gas fraternity for a great number of years.

Besides these gases, we have in coal gas benzol vapor to a slight per cent. In water gas we have naphtha vapor. Both of these vapors add materially to the illumination of the gases.

These three gases—olefiant gas, oil gas and acetylene—form the great bulk, in fact the whole, of the illumination of what we call illuminating gas.

In the making of illuminating gas we find certain impurities which have to be removed before the gas is in a condition to give the best results in combustion. The first of these impurities which I shall speak of is carbonic acid; composition, CO_2. One hundred cubic inches of this gas weigh 47 grains. It exists in coal gas to a varying extent from 2 to 5 per cent., according to whether the gas is exceedingly dry or moist. It varies in quantities of from 2 to 10 per cent. in water gas, depending entirely upon the heat. It is a gas that will not burn itself, but will prevent other gases from burning. It is claimed that 1 per cent. of this gas will deteriorate coal gas 1 candle. It is probably not as deleterious with water gas, yet it is a very undesirable article to have in the gas. If we introduce a lighted candle into a jar of this gas, you will see how quickly the flame is extinguished. If we pour a jar of this heavy gas upon a lighted gas, you see that it extinguishes the flame, but also that it is an exceedingly heavy gas, for you can pour it as you would water. And yet if we take this gas and pass it through a vessel containing vapor of gasoline, to your surprise you will see that it burns with quite a brilliant flame. Understand that it is not carbonic acid that is burning, but simply the vapor of gasoline that is carried along with the carbonic acid.

The next impurity that we speak of is sulphureted hydrogen. This exists in coal gas to a variable extent, depending upon whether the coal is highly charged with sulphur or not. It exists in very much smaller quantities in water gas. It has a composition of one of sulphur and one of hydrogen. One hundred cubic inches weigh 17 grains. Sulphureted hydrogen burns with a pale blue flame. As far as combustion goes, it would not be an undesirable gas, but the products of combustion—sulphurous and sulphuric acid—are exceedingly undesirable. Sulphurous and sulphuric acid not only will bleach, and will rot the tissues of the furniture of the room, but also is a very undesirable article to breathe. Hence engineers are very particular to remove this gas to the fullest extent.

The next gas is ammonium; composition, NH_4. One hundred cubic inches weigh 18 grains. Ammonium exists to a greater or less extent in all coal gas, but we find scarcely a trace of it in water gas, owing to the high heats under which water gas is made. Ammonia itself is not an undesirable article in a gas, but the products of combustion are very undesirable. As it burns in ordinary flame, nitrogen is simply set free, and we have nothing besides but the vapor of water; but, owing to the higher flame temperature at which the gas is burned, the nitrogen is converted into nitrous and nitric acid gases, which are exceedingly destructive to furniture, and are very deleterious to breathe. Hence engineers remove, as far as practicable, every possible quantity of ammonia. It is exceedingly soluble in water, one cubic inch dissolving 700 cubic inches of this gas.

These three gases are considered impurities, and in all well made gas should be removed.

Besides these gases we have a trace of cyanogen (composition, C_2N). This gas burns, as you see, with a beautiful rose-colored flame. Probably you have noticed that same rose-colored flame in certain coal gases that you may have made from various coals. It is in no wise a deleterious gas, and as it is not readily separated I no not know that it is in any wise injurious.

Another gas to which I might call your attention is phosphoreted hydrogen. As all coal contains more or less phosphorus, we are very apt to find slight traces of phosphoreted hydrogen. The only peculiarity about it is that when exposed to the atmosphere it readily takes fire. If I throw some phosphide of calcium into water you see it readily gives off gas, and as the bubbles come in contact with the air they take fire. It is the "will-o'-the-wisp" that we read of so much as having been often seen in certain marshy localities.

There was a time when the question was asked why it is that we make from 85 to 95 per cent. of a non-illuminating gas when it is only 5 to 10 per cent. of the gas that gives us illumination? At that time we had not constructed burners that would burn such rich gas without smoking. At the present time we have so changed the business of gas making and the selling of gas that we now require gas that not only contains illumination but also heat. In fact, we are selling as much gas now for heating purposes as we do for illumination. Hence a mixture of non-illuminating and illuminating gases is at the present day most desirable. For the purposes of heating, the present composition of coal gas comes as nigh perfection as we can well hope for. If, by adding acetylene, we can add somewhat to the illumination, it would be desirable. The make of water gas, using as we do a large percentage of naphtha, gives us a sufficient number of heat units to make this a very desirable heating gas also.

If we study the composition of illuminating gas as made to-day, either

from coal or water, we find that there is very little improvement to be hoped for, as it is near perfection for all the uses that gas is put to at the present time.

[Concluded from page 651.]

The Legal Aspects of Electrolysis.

[By Mr. Henry C. Townsend, in *Cassier's Magazine*.]

In prior adjudications upon the rights of telephone, telegraph and electric light companies, as joint occupants of the public streets, courts have apparently found difficulty in dealing with the subject, because in the strictest sense, there is no physical invasion of the property such as exists in the case of the flooding of lands or trespass on property. Modern research, it is true, indicates that light and electricity are but different manifestations of properties of the same medium, filling all space and termed ether, and modern theory goes so far as to assert that such apparently diverse forces as electricity, light and gravitation are properties of this one universal and all-pervading ether.

A recent Secretary of the Treasury of the United States has ruled that electricity, conveyed by conductors laid across the frontier, is not dutiable, being, as the learned Secretary puts it, "intangible and not capable of being measured," and a State court has exempted an electric light company from taxation as a manufacturing corporation on the ground that electricity is not a manufactured article.

Nevertheless, although electricity is not a substance or fluid in the ordinary sense, the idea of fluid pervades the whole language of electrical science, and even the definition of electrical units, as adopted by all scientists, suggests a fluid theory, and so the analogy of water naturally suggests itself in dealing with the present subject. So dealt with the law furnishes many analogies in its treatment of the rights of riparian owners and of persons injured by water, heat or other natural agent. Many of these analogies support the proposition that the invasion of a telephone company's plant by foreign and superior currents, if producing a serious interruption of, or interference with, its use, is a damage for which the law gives a remedy, but the analogy approaches much nearer to exactness in the cases where the injury goes beyond the mere annoyance or temporary interruption to use, such as was considered to exist in the case of the telephone companies, and involves the actual physical destruction of the property invaded, as is the case of corroded water and gas pipes or telephone cable sheaths. These injuries cannot be dismissed as mere incidental inconveniences, unavoidably following the use of electricity for street car propulsion. The damage is a continuing physical one, and is repeated with every repair. It is, moreover, the natural proximate and immediate result of the use of the ground return, chosen by the companies in preference to the double trolley, mainly for their own convenience and profit rather than for giving increased speed of transportation.

It has been urged, as in the telephone cases, that the demand for damages or injunction by those whose previously acquired property, or rights of property, are injured by the railway currents introduced into the earth, amounts to a claim to the monopoly of the use of the earth. But priority of enjoyment of a right is frequently a factor in determining what is or is not a nuisance. Thus, it was held to be a nuisance in a certain case for the defendant, a pastry cook, to put into a room in his house which adjoined a room of the plaintiff, previously long used as a wine cellar, a stove so large that, when it was being used, it heated the wine cellar and made it useless for its purpose.

Blackstone says of nuisances: "If one does an act in itself lawful, which, yet being done in that place, necessarily tends to the damage of another's property, it is a nuisance, for it is incumbent on the person to find some other place to do that act where it will be less offensive." And it is a general rule that acts, lawful in themselves, may become unlawful if exercised without regard to time, place and circumstances. An offensive trade may not be established on one's land to the prejudice of the previous occupants of neighboring land; but if the neighboring land be not occupied there is no nuisance.

In the previously mentioned case of the railway repair shops, established on land owned by the company, to the interference with the enjoyment of neighboring property, one of the grounds upon which the court granted relief was that the property had been acquired and put to the special use which was interfered with, long before the railroad shop was built.

A distinction exists between such injuries as may result from the uses of the public streets by different persons, owing to a conflict of their interests and methods of use, and such injuries as may result to the rights of the owners of abutting property, due to corporate or other acts in a street or highway. As between two occupants of the public highway, each exercising its right by legislative authority through the power of control which the State has over the streets for public uses, the State may, in the exercise of its power of eminent domain, authorize a beneficial use in a manner to work an injury to another use beneficial to the public, if public necessity or convenience may require it. But this is subject to the constitutional right of the person injured to just compensation if the injury amount to a taking or damage, or amount to more than a mere incidental injury or inconvenience. But, in respect to abutting property, there resides in each owner an easement or right to the unrestricted use and enjoyment of the street for purposes of access for drainage, supply of heat, light, water, etc., which the law recognizes as appurtenant to the land and not passing with any conveyance of the street or land thereof to the State or corporation for street uses.

Each lot owner has a peculiar interest in the street which neither the State nor the municipal corporation, nor the general public can pretend to claim—a private right of the nature of an incorporeal hereditament legally attaching to his continuous grounds and the erections thereon; an incidental title to certain facilities and franchises. This easement, appendant to a lot, is as much property as the lot itself. For an injury to that right the law gives the landowner a remedy by injunction or award of damages, according to the nature and the circumstances of the injury.

While the electric railways may lawfully occupy the streets for the purpose of facilitating the uses of the streets for passage and transportation, they cannot impair or lessen lawfully an abutting owner's easement in it by any method of operation which attaches to the maintenance and use of the electric railway in any special or particular manner. As was held in the elevated railway cases in New York, the use of the streets by the railway structure operates to take from the abutting lot owner a portion of his easement in the street, without making compensation, and, hence, as to him, it is illegally there, although, so far as concerns the public, the rights of the road could be allowed to stand. The illegality in respect to the lot owner was not in making use of the franchise legally granted, but in appropriating a part of the owner's easement without acquiring it by negotiation or condemnation.

In this particular case the easements taken were those of light and air, impaired by the presence of the structure and by smoke, cinders, gases, etc., which were necessary accompaniments of the operation of the road. But there are other easements which undoubtedly belong to the abutting lot owners, namely, the right of gas and water connections; and, if these be impaired by the use and operation of the electric railway, there is an injury or damage for which the owners are entitled to compensation.

The appropriation of the land forming the street for street uses carries, by implication, the extension of those in vogue at the time of the grant, dedication or conversion, to those which the progress of civilization and the growing demands of increasing population may require; therefore, a use of the streets for cars or vehicles propelled by electricity, in so far as increased rapidity of movement may be beneficial, is within the purposes of the original use. But this principle cannot be equitably extended so as to legalize particular ways of employing the electric force which are inconsistent with, and subversive of, those prior, necessary uses of the soil of the street for carrying water and gas pipes, or of the right of the abutting owner to make connection with them.

While, therefore, the courts may dismiss the claim of a telephone company for damages arising from joint occupancy of the streets because the injury is the result of a joint attempt of individuals to make use of that to which each alike has a right, and is produced without fault or negligence on the part of the railway company, no such disposition would necessarily follow as to any claim which the owner of an abutting lot might make for damage to his easement in the street for the purposes of water and gas pipe connection, because, on principle, that use stands practically upon the same footing as his right to secure light and air from the street.

A remedy exists for the injury by corrosion to which buried pipes and cables are at present exposed through the operation of the electric railway companies, and while the difficulty is, from the electrician's standpoint, best met by resort to the double trolley, there is sufficiently reasonable expectation of relief from the expedients which are now being proposed to free the railway companies from the charge of negligence.

The remedies now proposed will in any case probably so diminish the evil that it will become difficult to place the liability, or to say with certainty that the extent of corrosion to be hereafter observed is not attributable rather to the direct corroding influence of the constituents of

the earth itself or to the decomposing action of the weak currents which may be set up, as in an earth battery, by different sections of pipe or cable, electro-positive and negative to one another either by reason of the difference of the metals themselves, or by different kinds of earth in which neighboring, similar metals are buried.

It is beyond the compass of this paper to discuss the different ways in which feeble earth currents may be set up, but inasmuch as recent experiments seem to show that a mere directive force in the way of electric pressure, even so low as 0.001 of a volt, is sufficient to produce electrolysis of the earth salts and liberate corroding agents, it is quite obvious that without resorting to the double trolley the corrosion may be so far diminished by other proposed means that the responsibility for the corrosion remaining cannot be fixed upon the railway companies.

The New Science of Electric Heating.

[By Mr. W. S. Hadaway, Jr., in *Engineering Magazine*.]

Heat is so closely allied to an adequate shelter in warming, and to food in cooking, that we must regard it from the practical standpoint of a prime necessity, and, in treating of its generation and distribution, base our deductions largely on whether the owner of a particular form of heating apparatus can operate it economically, and whether the user or party to whom the heat energy is furnished can employ it as cheaply as other forms of heat supply, with reasonable regard for collateral advantages. A heating system, to be an advance on existing methods, must be a source of wealth to the owner and a source of economy to the user.

A system of heat and electrical generation and transmission derives its value largely from the benefits of concentrated control, like other systems of public works. We are to regard heat agents as commodities which can be economically generated, transmitted and applied. Electricity as a heat agent is not to be regarded as a source of heat, as that expression is generally understood, but, technically, as the high potential heat factor in a telethermal system, where the heat secured is generated by simple resistance; or, we may employ electricity as an agent for producing available heat in operating a thermal engine by means of motors.

Of the fuel consumed under good steam boilers at least 65 per cent. of the heat energy is available for useful work. Steam in the best of steam engines theoretically possible can only transform 25 per cent. of the boiler energy into active mechanical work, and in practice 12½ per cent. is not generally exceeded. The engine work can be very economically transformed into electrical energy, in which form, considering it as heat, transmission losses are relatively small. In good steam and electrical practice the heat engineer can secure about 10 per cent. of the fuel energy in electricity, and of the balance of the fuel energy may write off 35 per cent. as direct loss and 55 per cent. as indirect loss. The indirect loss can be utilized with a properly arranged system of steam distribution over limited distances; and the combination of the electrical energy, available for heating purposes at varying temperatures, but usually above 212° F., and the exhaust steam, available for heating purposes at temperatures below 212° F., the writer has termed a multi-potential thermal system, in which electricity is employed as the high potential heat factor and exhaust steam as the low potential heat factor, and in which the heat energy is available for use in a telethermal system. That is, in practice, we have a system in which the ratio of high-potential heat to low-potential heat is about 1 to 5, figured from thermal units and not temperatures, and in which the total fuel efficiency is about 50 per cent.

In domestic and industrial work we find two broad classes of heat control. The first class includes operations requiring diffused heat on a large scale, as in room and water heating, or heat of low potential and large quantity. The second class includes processes where heat is used at high temperatures and in small volume, as in cooking and laundry work and in many industrial operations, or heat of high potential and small quantity. A reasonable estimate of the relative thermal units employed in each class is found, after careful investigation, to be about 5 to 1, assuming as a line of temperature demarcation 212° F. The average temperature differences between the two classes are not in the same ratio as the quantities, with this unit, but are sufficiently great to warrant a distinction between prices for heat energy at low potentials and at high potentials. What this difference in price should be can only be conjectured, but a fair rate of charge would seem to be not far from four or five times as much for high-potential heat as low-potential heat.

A practical illustration of the multi-potential heat system may be found in the requirements of a modern apartment house in which there are several families, each with a kitchen and small laundry under the tenants' control, and with electric lights, steam heat and hot water supply, from a common source. The house equipment would consist of boilers, engines, dynamos, etc. The incandescent lamps, ovens, grills, flat-irons, etc., would be heated by electricity. The rooms and the water for bathing and culinary purposes would be heated mostly by exhaust steam. The owner would derive practically two profits from the fuel burned—a direct revenue from heat supplied for cooking and laundry work, and an indirect revenue from utilizing the secondary products of the first.

In present practice the owner equips the house with gas ranges, which are a source of direct revenue, not to himself, but to the gas company. Electric lights, hot water and steam heat are furnished by the owner, and figured as part of the rental value. The lights load is of so brief duration that the hot water and steam heat must come from live steam for a considerable part of the day. With a somewhat larger engine and dynamo, on the plan outlined, the live steam used would be largely supplanted by exhaust steam, on account of the larger load factor, besides providing a direct revenue to the owner to pay for fuel, labor, etc. The cost to the user of the electrical energy for cooking and laundry work at 4 cents per horse power hour is not greater than gas at $1 per 1,000, provided all water heating is omitted and the electrical apparatus fairly well controlled. The user or tenant secures a great number of collateral advantages, which represent the same advantages for less money or more advantages for the same money, and the owner may convert an expense into a revenue.

The illustration brings "electrical heating" within our definition of an advance in heating systems, and shows a sufficient reason why the subject should receive the respectful attention of capitalists, property owners, and their architects. It also shows that the expression "electric heating" is an unfortunate one, as the problem is one for the heat engineer, in which steam and electrical engineering are elements, and in which the electricity used is the thermal equivalent of only about one-sixth the heat energy distributed and applied.

There is, to the writer's knowledge, no installation extant completely illustrating the multi-potential system of heating. The Yaryan installation of central station hot water heating at Toledo, O., described in *Heating and Ventilation* (Feb. 15, 1895), closely approaches it, and lacks only the application of electricity for cooking and laundering in the houses heated; and this installation is especially noteworthy in using water for thermal storage and circulation in connection with the exhaust steam heat storage. In the *Electrical Engineer* (April 5, 1893) will be found a description of the Springfield (Ills.) electric light and steam distribution plant. This installation approaches the hypothetical illustration closely enough to remove all reasonable doubt as to the strict accuracy of the deductions made for the multi-potential system.

In developing electric central stations the desirability of a large load factor is apparent. With full knowledge of the requirements in various cases, data on electric cooking and heating have been patiently and carefully collaborated. The result entirely confirms theoretical deductions as to the extent to which the station can provide at a profit the energy for cooking and heating. There is no doubt that the central station can furnish at a profit the high potential factor in the thermal system. The question now rests as to whether the customer or householder will find a divided heat supply desirable. Of the six parts used, the electric central station can provide one-sixth, the high temperature part, the customer himself burning coal, or gas, to furnish five-sixths of the heat. The electric central station can operate electrically-heated chafing dishes, and pots for 5 o'clock teas (replacing the alcohol lamp); curling irons; plate warmer in the pantry; laundry irons; small water heater for nursery; bath, and dressing room warmer, etc., and these specialties can all be made to increase revenue without adding materially to the construction account. At a 5-cent rate per H.P. hour the devices enumerated are perfectly practicable; and other specialties, like shaving mugs, toddy heaters, egg boilers, hot plates, etc., are coming into use. These are all of value as a source of revenue to the electric central station and of convenience to the users, but it must be doubted whether, with so small a percentage of residence lighting as is now connected, and with the inability to offer but a partial heat supply when connected, electric heating apparatus, in which the heat is derived from simple resistance, will entirely provide the balance in the load sought for.

To illustrate the capacity of an electric station as a heat producer we may compare the prices charged by the New York Steam Company and the Edison Electric Illuminating Company, of New York, both operating in the same district and supplying steam and electricity respectively. Using the figures given by Dr. C. E. Emery as the basis of charges for the Steam Company, we find that it furnishes heat to large consumers

at 40 cents per 1,000 kals, the kal being the equivalent of 1,110 thermal units. For 40 cents 1,110,000 heat units are supplied. Taking the Edison Company's rates, and using the 50 per cent. discount as the rate to a large user, 40 cents will purchase 8-horse power hours, or 20,518 thermal units. The ratio between the two is nearly 54 to 1; or, as a loss must be figured in the case of steam, dependent upon the temperature at which the condensed water is allowed to escape, practically 50 to 1. It would be unjust to leave the figures on the mere heat equivalent of the two forms of energy, as high potential heat energy is almost universally secured by localizing a small proportion of fuel energy and allowing the rest to escape, and is consequently worth more per heat unit; but, even were we to admit as a reasonable charge five times as much for high potential heat as for low potential heat, the ratio is still 10 to 1, and indicates what might be accomplished could the two plants be run conjointly for a multi-potential heat supply.

Lord Kelvin, in an article "On the Economy of the Heating or Cooling of Buildings by Means of Currents of Air," published in the Glasgow Philosophical Proceedings, Vol. III., December, 1852, and followed by mathematical demonstrations in the *Cambridge and Dublin Mathematical Journal* for November, 1853, has made some most interesting deductions.

"In the mathematical investigation it is shown that, according to the general principles of the dynamic theory of heat, any substance may be heated 30° above the atmospheric temperature by means of a properly contrived machine driven by an agent spending not more than about $\frac{1}{15}$th of the energy of the heat thus communicated; and that a corresponding machine, or the same machine worked backwards, may be employed to produce cooling effects, requiring about the same expenditure of energy in working it to cool the same substance through a similar range of temperature. When a body is heated by such means, about $\frac{14}{15}$ths of the heat is drawn from surrounding objects and $\frac{1}{15}$th is created by the action of the agent; and, when a body is cooled by the corresponding process, the whole heat abstracted from it, together with a quantity created by the agent, equal to about $\frac{1}{15}$th of this amonnt, is given out to the surrounding objects."

In editing his "Mathematical and Physical Papers," Lord Kelvin added the following interesting note under date of June 26, 1881: "The method of cooling air in unlimited quantities described in this article has been realized by Mr. Coleman, first in refrigerators used for the distillation of paraffine, and, after that, in the Bell-Coleman refrigerator for carrying supplies of fresh meat from North America to Europe; in a great refrigerator recently sent out for the abattoir at Brisbane, Queensland, etc."

When Niagara is set to work for the benefit of North America through electric conductors, it will no doubt be largely employed for the warming of houses over a considerable part of Canada and the United States. But it is probable that it will also have applications, though less large, in other cold countries to multiply the heat of coal and other fuels, and to utilize wind and water powers (with the aid of accumulators) for warming houses.

The accomplishment of this form of heat control would enable us to construct uni-potential thermal systems, in which the high potential factor wonld be secured directly by the heat of resistance and the low-potential factor by employing electricity as agent to operate by a motor a device like that outlined by Lord Kelvin. A system of this sort would appear to largely increase the central station load factor, and we would simultaneously introduce a large summer load by employing the same device, in reverse cycle, for cooling.

Of course many minor modifications of the two thermal systems outlined will suggest themselves. The gist of the whole matter is that for electric heating (or its synonym, central station heating) to be economical a multi-potential thermal system must be operated, which is entirely feasible over moderate distances; or, assuming that electric central stations are to continue to run with the present deplorable fuel economy, the second or uni-potential system is the only feasible one, considering the whole subject in its broadest sense, and remembering that, while the device to accomplish the results sought is shown to be theoretically possible, it has not yet been entirely developed.

Where a complete thermal system is to be constructed, with coal or low cost carbonaceous materials as fuel, the multi-potential combination is the direct way to secure high fuel economy and profit to the owner and user; and where only the mechanical equivalent of heat is available, as from motors, water powers, gas engines, etc., we must interpolate a device for diffused heat control to heat buildings, and water for use in same, in addition to the energy for high temperature work, which we can profitably secure from direct heat of electrical resistance.

Results already accomplished in electric heating depend wholly upon the high potential factors of the broad systems outlined. The time is not ripe for a comprehensive review of the collateral benefits derived from a highly localized form of heat energy, our concepts of the elasticity of which are only measurable by concepts of the rigidity of the ether. Instead of a concerted effort to create a field of use for the apparatus by constructing complete thermal systems, nearly all of the applications have been made as minor incidents in systems of electric lighting and power already established. This, of course, is logical pioneer work, but it fails to reach the vital elements necessary for full development.

The famous "Electrical Heater Man" at the Franklin Institute in 1884 was the butt of the practical jokers among his co-exhibitors. The apparatus there shown was the first form of the electric car heater, with which to-day upwards of 5,000 cars are equipped. The status of the electric car heater is peculiar; it cannot be regarded as an economical device, but rather as a public requirement. An electric car is too small and crowded to admit of an economical and efficient isolated system of heating. Again, very little actual heat is required under average conditions, but rather a small amount of sensible warmth, uniformly distributed to each passenger on the basis of individual effectiveness. This can be met by an electrically heated radiant at an energy consumption of less than 100 watts per square foot of surface, and, in the common 20-foot car 20 square feet of radiating surface are sufficient for average conditions, and 35 square feet of radiating surface for extreme conditions.

Too little regard has been paid to the item of individual effectiveness in rendering cars comfortable. So much energy has been wastefully used in air warming, even under average conditions, as to render the power consumption a most serious matter. The result is to give an unjust impression as to the cost of making cars habitable by electric heaters, and in the case of elevated roads, using large cars in trains, the item is a still more important one, as the energy for heating may equal or exceed that for propulsion. Again, in the case of elevated roads there seem no good reasons why the small rooms in the stations along the line should not be heated by the same agency as the cars, and in economical work of this magnitude we appear to be forced back to the uni-potential system using electricity as agent.

In small cars the heat of resistance is not excessively expensive. As in the case of the Vaudeville Theater installation in London, there are peculiar local conditions which, as practice has proven, can be satisfactorily met with resistance heaters. But, while under ordinary circumstances we can heat bath and dressing rooms in residences by resistance heaters quite cheaply, considering intermittent use, we would not attempt to heat the whole house by the same means. If electric roads would locate their stations contiguous to business blocks and utilize their exhaust steam for heating purposes, there would be no difficulty in meeting the requirements of cars and station heating on a large scale by resistance heaters. The *Railroad Gazette* (March 22) has given some interesting figures on "The Cost of Heating Cars by Electricity," in which comparisons are made between heating large cars by electricity and by steam. As a general rule, the smaller the divisions of space and the more intermittent the use, the greater is the economy of electric heating; and we may include in this rule water heating as well as space heating.

Cooking by electricity is an important part of electric heating. In practice it means the accomplishment of high temperature processes by resistance heaters, using other sources of heat energy for the hot water supply and, preferably, water boiling processes, as in vegetable cooking. One of the most complete analyses of this subject which has appeared was published in *Science* (Sept. 15, 1893). The deduction is made that electricity at about 11 cents per horse power hour is as economical as the common coal range for cooking, provided the electricity is used to heat an oven, the hot water being secured from outside sources. This appears to presuppose a radical change in cooking methods and apparatus, and, while this is undoubtedly proper in order to get best results, practice has seemed to require at the outset a more elastic system, in which the utensils conform to the generally accepted notions of what shapes and sizes should be.

To this end an experimental plant has been operated for 15 months in charge of a cook without special instructions as to the best method of operating the apparatus for economy, the desideratum being that good cooking shall be done and the utensil disconnected from the circuit when the cooking is completed. The equipment consisted of an oven, broiler, portable stoves, spider, plate warmer, coffee pot and small tea kettle. The result has shown that, with apparatus conforming generally to the accepted notions of cooking utensils, the cost of electric cooking is practically equal to that of the gas and coal stove as generally run,

when electricity is supplied at 4 cents per horse power hour. This does not show what can be accomplished under best control, but is a practical result in common usage.

The economy of electricity as a thermal agent in cooking is not doubtful, provided the uses to which the various forms of heat supply are put are proportioned in accordance with their heat equivalents, limiting electricity to high temperature work. In combination with steam, both live and exhaust, there appears to be no reason why hotels and public institutions, operating their own plants so as to secure a multi-potential system, should not employ electricity in cooking very extensively, solely for the purpose of economy; for electricity in a well designed isolated plant costs much less than 4 cents per horse power hour, especially if we utilize the bye-products of its generation in useful work, as would be the case in a complete thermal system. Ethical considerations in connection with electric cooking are of value after the economy and simplicity of the apparatus are established. Cleanliness, localization of heat at predetermined temperatures, and coolness of the kitchen, are important factors in connection with the servant problem. The use of electric cooking apparatus in cooking schools is important, as constant temperatures are easily produced over extended periods.

In industrial work the applications of electric heating are rapidly multiplying. Nearly every manufactory of size has its own electric plant, and can secure electricity at low cost. In operating sad irons and tailors' gooses, small glue pots, soldering irons, pitch heaters, etc., sufficient compensating advantages are found to offset increased prime costs, in case they occur, and the outlook for extended applications in the industrial field is favorable. The ability to minutely subdivide the heat energy, or, in other words, the elasticity of the system, makes it of special importance for use in manufacturing work.

It is impossible, within the prescribed limits of this article, to give more than a passing glance at the different factors in electric heating. We may perhaps best sum up the various sides of the problem as follows:

1. In constructing a thermal system, we may employ electricity as the high potential factor, by resistance heaters, or we may employ it as agent in operating motors to drive a suitable machine to secure diffused heat control.

2. In a multi-potential thermal system the useful heat available is practically 5 parts low potential heat and 1 part high potential heat. In domestic life the ratio of heat required is found to be practically 5 parts diffused heat and 1 part high temperature heat. Over limited distances we may therefore economically operate multi-potential thermal systems using electricity as the high potential factor.

3. Electric heating is synonymous with central station heating, presupposes the same generic elements, and requires for economy a complete thermal system, in which due regard is paid to proportioning the work done in accordance with the heat equivalents of the factors employed, all of which must be in such form as to constitute elements of a telethermal system.

4. Where the mechanical equivalent of heat only is available, as from motors, water powers, gas engines, etc., we can economically employ electricity only for high temperature work; for diffused heating on a large scale we must employ it as agent.

5. By constructing complete thermal systems, in which steam and electrical engineering are factors, the heat engineer can make electric heating a source of wealth to the owner of the system and a source of economy to the user of the heat energy, and therefore secure an advance on existing heating systems.

Carbon Dioxide for Refrigeration and for Extinguishing Fires.

[Abstract of a paper read by MR. E. F. OSBORNE, of the Western Society of Engineers.]

Attempts have been made to distribute artificial refrigeration in a limited territory by the use of anhydrous ammonia. The cost of this material necessitates its return to the central station, involving, in the construction of a plant, not only the pipe for its distribution, but pipes and fittings larger and several times more expensive than the distributing pipes, for its return; and in practice it has been found necessary to employ three pipes, with the attendant complication and expense, both in construction and maintenance. The meter measurement to the consumer is not satisfactorily operative, and automatic regulation is impracticable, if not impossible; still, the demand is so great for even this crude service, and it is so much superior to the use of ice that consumers cheerfully pay a price sufficient to make a small and expensive plant of this kind commercially remunerative. Furnishing a product without measurement is commercially possible only on a limited scale. I do not wish to detract one iota from the credit that is due to those who have perfected the ammonia refrigerating machine, but the causes that have almost invariably effected a failure in district steam heating plants operate to produce a failure in district refrigeration by the ammonia process, to wit: Too great complication and expensive construction, no practical system of meterage or means of regulating the effect produced, together with excessive expense for maintenance and inspection.

Pipe line refrigeration has come to stay, and will displace ice for nearly all purposes for which the same is now used; and some system other than that in which ammonia is used must and will be used in all places where refrigerating effects are to be produced on a large scale, and divided among many small consumers, in the same way that natural and fuel gas has replaced steam for heating purposes under similar conditions. Carbon dioxide is the substance to be employed for the following reasons, namely:

Less cost of production, less complication and therefore less expensive construction; less cost of maintenance and less need of inspection, together with accurate measurement of product and easy regulation of effect, with incidental uses not obtainable with ammonia.

The following may be called a commercial law: No commercial enterprise on an extensive scale can attain and maintain enduring success that must recover its product; that has no substantially accurate and readily comprehended means of measurement upon which to base charges for product furnished, or that cannot regulate, either automatically or readily by the assistance of the consumer, the effect produced by the product furnished.

Carbon dioxide possesses the physical properties and can be produced, delivered and furnished to small consumers under such conditions as to force its adoption for the many purposes for which it is so pre-eminently adapted. It can be produced so cheaply that its recovery would materially increase the cost of its production. It is comparatively a harmless gas, as it is a necessary constituent of many articles of food and drink. It is the best available refrigerant known to science, being capable of producing a temperature in a few minutes even more than 100° below zero, F. It is, therefore, useful in many chemical processes where ammonia could not be employed. It is odorless, and neither inflammable, corrosive nor explosive. It is the best preservative of furs and woolen goods known, keeping them from the ravages of insects and worms without impregnating them with any odor.

The loss occasioned by the average fire is due more to the water than to the fire. In many cases the amount of goods actually consumed or damaged by the fire and smoke is less than $\frac{1}{10}$ of the damage done by the water used to extinguish the fire.

The well known properties of carbon dioxide to extinguish fires have been used in portable fire extinguishers and chemical engines. One of the advantages of carbon dioxide for extinguishing fires is that the heat produced by the fire assists in its own extinction by inducing a current of mixed air and carbon dioxide to flow to the point of combustion, and thereby extinguishing or wiping out the fire just as water would be wiped off from either a vertical or horizontal surface with a dry sponge or rag drawn over it.

I have devised a system and devices by which carbon dioxide may be produced in a liquid form on a large scale, at a comparatively insignificant cost; and have devised processes, methods and apparatus for its utilization. The devices are simple in construction, readily understood by the average mechanic; they are easily constructed and put in operation and can be tested at any time without danger to the operator.

It requires but a very small amount of gaseous dioxide to extinguish a fire in its incipient stages, from 4 to 10 per cent. is ample. As the gas comes out it falls to the floor, mixing with the air as it goes. The heat caused by the fire induces a flow of the mixed air and gas to the exact place where the combustion is going on, and immediately extinguishes it. As soon as the fire is extinguished, the temperature of the air at the ceiling is reduced, the thermostat ceases to operate, the automatic valve closes, and the apartment is in the same condition as it was before the fire.

This gas can be adapted for use in refrigerator cars. It will also give preservation with a dry atmosphere, with but little refrigerative effect, or a freezing temperature to keep frozen goods.

The system consists of a central station provided with one or more gas producers, calcining retorts, distilling apparatus, boilers, engines, pumps, compressors and incidental apparatus. The raw materials required are soft coal and limestone. The products are carbon dioxide, commercial lime, carbonate of ammonia and coal tar.

The coal is supplied to retorts and subjected to destructive distillation in nearly the same manner as in ordinary gas works, the tar and ammo-

niacal liquor being separated, the former being sold in that state and the latter distilled and converted into carbonate of ammonia, packed and sold. The coke is converted into a semi-water gas, which is used to calcine the limestone. The lime produced is of the best quality and is sold on the open market either in bulk or by the barrel. The dioxide is purified, cooled, compressed and liquefied in the same way as is done in ordinary manufactories where this substance is produced for commercial purposes. The liquid dioxide then passes by its own pressure into the main distributing pipes in the street. At the curbstone is a service cock; just inside of the consumer's premises is an automatic valve, which cuts off the supply in case of a break or careless management of the apparatus on the consumer's premises; if the break is permanent, or anything has happened equal to a rupture of the service pipe, the supply remains substantially shut off. When the damage is repaired and normal conditions established the supply is automatically turned on. From this valve the dioxide passes to a meter, thence to the automatic regulating valve in the refrigerator, which is set to maintain any temperature desired, from which valve the dioxide is conducted into the cooling chamber or coil located in the space to be cooled. Thereafter the dioxide in gaseous form may be used to charge drinking water, ale, beer or wine, and for forcing these or other liquids from a lower to a higher level, as from the basement of stores and restaurants to any floor above; or the gas can be used for the preservation of nearly all kinds of food products, where a low temperature is not necessary, especially for fruits, vegetables and meats. It can also be used for small powers, and the heat that is extracted from the substances cooled goes a long way towards furnishing the motive power required in connection therewith.

Briefly, the services above referred to are to be furnished from a central station, somewhat similar to a gas or water works plant, and the carbon dioxide, after its production, delivered into flasks or cylinders for use on board cars, ships, or at other places not directly connected with the central station. Or the dioxide is delivered into a ramification of pipes leading to the premises of the various consumers, where it is metered, automatically regulated, and the resulting gas allowed to go to waste.

One ton of good soft coal and 3½ tons of limestone will produce rather more than 3,500 pounds of lime, 3,000 pounds of carbon dioxide, 6 or 7 gallons of coal tar, and 40 to 50 pounds of carbonate of ammonia.

Some of the Fire Dangers of Electricity.

The *American Exchange and Review* says that on April 5th, at the request of the Executive Committee of the Philadelphia Fire Underwriters' Association, Inspector Wm. McDevitt, of the electrical department of the Association, gave a series of demonstrations at the Merchants' Exchange illustrating ignitions from defective and unskilful electric wiring.

In his opening remarks, Mr. McDevitt dwelt upon the necessity of considering the increasing use of electricity as a fire question, especially in view of the general introduction of the trolley motor, and also the tendency toward complete electric equipment in modern dwellings, both as to incandescent lighting and gas lighting systems. Many fires which had heretofore been a puzzle to fire authorities, the Inspector thought gave evidence of electric origins; and in most electric fires the primary reason of ignition has been lack of precaution and unscientific installation; consequently, the importance of employing skilled labor in the wiring of buildings, and of setting a high standard as to the quality of materials used grow more imperative. The Inspector then proceeded to give a demonstration of ignition, which was directly referable to carelessness in relation to the incandescent lamp.

"I believe," he said, "that the general public are aware of the danger of enveloping the incandescent bulb with any fabric that shall confine the hot air and exclude the air from without. From past experiments that I have publicly made, and from actual fire occurrences, we have came to understand that it is dangerous to inclose the bulb with any material, even a fabric as light as mosquito netting. The danger is not restricted to the bulb; this [holding up an incandescent lamp socket] contains a form of fire hazard due to carelessness in setting up. The ends of the two wires that lead to a light are composed of filaments of smaller copper wires, put in contact with the lamp itself by being wound around binding screws and then fastened down. If any of the finer wires escape the notice of the workman and become separated from the main bundle, there is liable to be a short circuit from contact with the metal shell of the socket; and should the fixture happen to be bound or draped with any decorating fabric, ignition is almost sure to take place." To illustrate his remarks on that head, Mr. McDevitt wound some gauze around a socket that had been previously short circuited by unwinding some of the strands; and on passing a 100-volt current through the lamp the metallic socket at once burnt out and set fire to the gauze with a sudden explosion.

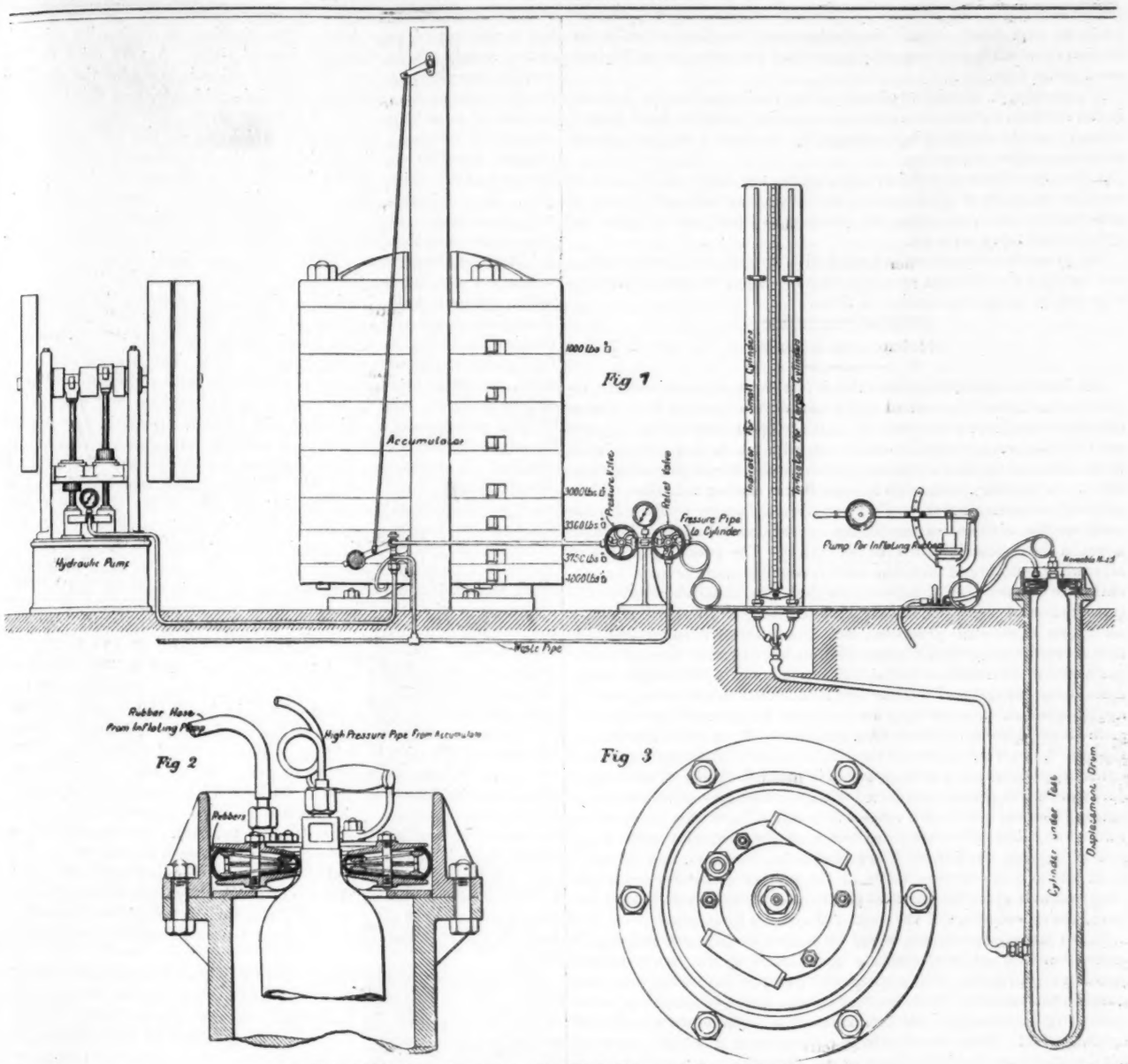
The next experiment was a reproduction of a fire that had been started by a live wire grounding with a gas pipe. A light wire was put in loose contact with a ¼-inch (internal diameter) gas pipe, through which a flow of gas circulated. On closing the switch that completed the circuit between the pipe and wire, the latter burnt a hole in the pipe in three counted seconds, igniting the gas and making a blaze a foot and a half long. Several specimens of pipe taken from electric fires were passed around for inspection, one being particularly noteworthy from the fact that it had been eaten through by streams of dripping water, which completed the ground circuit. About 7 inches of the pipe had been pitted through by the action of the intermittent sparking, allowing the burning gas to escape from a number of small holes.

The pendant cord, characterized by the Inspector as the "bugbear" of electric wiring, was then experimented on by bringing a frayed end in contact with the wire that completed the circuit. The silk insulation immediately took fire, and a foot of it burned until forcibly extinguished as it hung in the air. The great danger of flexible cords was shown to be their brittleness and rough handling by people who over estimate the use of portable lights. The first wrapping of wires was originally cased in a soft rubber tubing wound on the outside with silk or cotton covering. Experience proved that rubber was conducive to high flaming, and also afforded good material for a wick. Rubber has since been abandoned by the Philadelphia Fire Underwriters' Association, and the length of the cord restricted to 6 feet.

A number of conduits were then displayed as examples of the modern house wiring conduit system. The first of these was an ordinary conducting wire covered with a *papier maché* envelope soaked in a preparation of oil, the whole encased in partially flexible asphaltum tubing, flaked with silica glass on the outside. These conduits are comparatively safe, and are in general use in all the large cities of the United States. They are not absolutely fireproof, however, nor free from risk of abrasion, and will in time be superseded by metallic casings. The first step toward metallic coverings, by which a wire is isolated from all danger of external contact, is in the use of thin brass tubing to cover the asphaltum. In several instances the brass has been known to give way under pressure, allowing the inner coverings to become exposed to further mutilation. The Board of Underwriters now recommends the use of ordinary iron gas pipe with curved elbows. To show the superiority of the conduit system over unprotected wires, a length of about 20 feet of insulated wire was run through a 6-foot brass tube containing the regulation asphaltum. The wire was coupled in circuit with three incandescent lamps, and, on the addition of 10 more lights, the part of the wire outside the conduit began to smoke in less than five minutes and burst into flame. Part of the insulation and the molten copper dropped to the floor, while the wire in the conduit was found on removal to have sustained little injury.

As a final demonstration, another, and an entirely new source of electric fire, was brought up, the result of investigations made a short time ago in the case of the Vanderbilt mansion fire in New York city. The fire was caused by the protruding ends of an incandescent light wire coming in contact with a metallic wall covering stuff, composed principally of Dutch metal in the warp. Dutch metal is a brass alloy, rich in copper, and it is a good electrical conductor when woven into other fabrics in threads. Mr. McDevitt procured a small sample of similar goods and tacked it on a board, running two wires through holes in the back until their bare ends projected in front, in the same manner as wires are left sticking out of walls before the final adjustment of lamp sockets. On establishing a circuit through this piece of goods, a brilliant shower of sparks fell from the point of contact, and the fabric was in a blaze in an instant. The experiment gave evidence of the great risk in private houses of a wealthy class, where the tendency is toward metallic ornamentation, both in Dutch metal wall papers and in fabrics that contain metal thread. The woof of such fabrics being cotton or hemp, the flammable quality of the material is preserved, and a good subject for ascending flame is provided, especially as the fabric hangs somewhat loosely on the walls where it is placed.

In conclusion, Mr. McDevitt remarked that such expositions might be taken as belonging to Philadelphia's contemporary reputation of always hunting for trouble, but claiming, so far as comparative knowledge of electric fire outbreaks is concerned, that Philadelphia holds the lead, it is proper that Philadelphia should give evidence of the character of this trouble. He said further, that the experiments were intended for



Brier's Testing Apparatus for High Pressure Gas Cylinders.

public education, and expressed the wish that through the medium of the press, facts relating to the everyday fire hazards of electricity might be made matter of general knowledge.

The voltage used throughout was 100, a low figure in comparison with the 3,000 to 5,000 volts employed on the trolley circuits, with their high voltage proportionately more fire making when invading other imperfect systems. The experiments were conducted with practical apparatus, and were successful as showing in a simple way the many subtle causes that may bring about fires heretofore set down in fire reports as of "unknown" origin, or wrongfully attributed to some other source.

Brier's Testing Apparatus for High Pressure Gas Cylinders.

The illustrations show the apparatus devised by Mr. Henry Brier for testing the steel cylinders used for the storage of compressed gases, as made and employed by the Scotch and Irish Oxygen Company, Limited, of Rosehill Works, Polmadie, Glasgow. It will, no doubt, be remembered by many that an older form of this apparatus was put on the market in 1889 by the same firm. It suffered, however, from the objection that, with its fixed head or jointing ring, cylinders could only be tested for expansion from the shoulder downwards, and cylinders with large splayed bottoms could not be tested at all.

These difficulties are overcome in the apparatus shown by the use of a loose annular jointing ring or cover, which is fitted with inflatable joint surfaces on its outer and inner edges. This cover, as will be seen, is placed round the neck of a cylinder of any size or shape, after it has been lowered into the machine, and a perfect joint is made in a moment by allowing a pressure of water from any convenient source, of constant pressure, to inflate the rubber surfaces.

The primary object of this apparatus was to obtain an insight into the behavior of cylinders whilst under hydraulic test pressure, for it was feared that, under the old manner of treatment, many cylinders were being ruined by excessive testing, and were being stretched beyond their elastic limit. This was found to be the case, and faults are now shown and cylinders rejected which would otherwise have been considered suitable for service.

A cylinder to be tested is filled with water and placed in the envelope, which also is full of water. The joint ring cover is then put into place and its joint surfaces inflated round the neck of the cylinder as explained. The cylinder is next subjected to internal pressure, and its expansion is measured by displacement of water from the envelope. The water immediately commences to rise in the gauge glass on the first indication of pressure on the pressure gauge, and continues to do so until the maximum pressure is reached, on release of which it falls, with good cylinders, to its original position, showing that the elastic limit of the metal has not been passed and the cylinder is in no way damaged.

It will be seen from the engravings that particular care has been taken to render the apparatus easy and reliable to handle, and as little as possible is left to the responsibility of the attendant. All pressure

joints are kept strictly outside the displacement chamber, the only connection to which is that necessary to conduct the water to the displacement gauge tube.

It is necessary, in order to obtain correct readings, that the pressure in the inflating rubbers should be constant, and, where a fixed head of water is not obtainable, this is managed by means of a weighted piston, as shown on the engraving.

A few loose heads of different sizes enable the same machine to be used for cylinders of all diameters, and two gauge tubes are shown of different diameters, one being for cylinders of small, and the other for cylinders of large capacity.

The pressure accumulator is loaded with rings of cast iron in such a manner that the different pressures required may, without trouble, be obtained by using any number of rings.

Holophane Globes.

The London *Journal* remarks that it is a common experience in regard to mechanical inventions that a new development in a particular direction calls forth a number of ancillary appliances which improve not only the arrangement in connection with which they are designed to be used, but are also in themselves improvements of general adaptability. A familiar illustration in point is the sewing machine, which, although a mechanical triumph, was not a satisfactory working instrument until a notable corresponding improvement had been brought about in the cottons intended for use with it. The result has been that all sewing cottons and threads, whether specially manufactured for machines or not, are now of better make than was obtainable before the introduction of these machines. An interesting and important exemplification of the same process of mechanical improvement upon what may be called the principle of parallelism has just been brought under our notice in connection with the lighting industries. Welsbach incandescent gas burners and electric arc and incandescent lamps, are all novelties which have not only been received by the world as improved methods of lighting in themselves, but have also, as our "Register of Patents" bears witness, proved the fertile causes of attempts to improve lighting appliances and arrangements in general. Many of these latter devices relate to matters connected with, or subsidiary to, any artificial lighting service; and in this respect they might have been brought forward at any time before the introduction of the particular modern systems of lighting mentioned. The fact remains, however, that they are, to all intents and purposes, fruits of the greater concentration of inventive minds upon the practical problems of lighting which have followed the introduction of the improved systems in question.

One of the most promising of the fields open for practical research in connection with artificial lighting is indicated by the much debated question of diffusion. It is unnecessary to repeat here what has been stated in the course of recent controversies as to the relationship (or the want of it) between the luminous intensity of light sources and their lighting effect. Much remains to be cleared up on this head. But it is not disputed that the indications of the photometer are not the sole thing to be regarded in practical lighting work. If only for physiological reasons, the concentrated intensity of high power light sources is admittedly a drawback to their utility under conditions shown by photometrical tests to be those of their highest efficiency. The naked arc lamp is unmanageably intense; and the same may be said, in their degrees, of naked incandescent gas and electric lamps, recuperative gas lamps and highly carbureted gas flames. Even the most powerful oil lamps are not free from the same reproach.

With some lights the cure for this evil is easily found—it is simply to avoid using them of intensities beyond those which the human eye can comfortably endure when both the light itself and the objects intended to be seen by it are in the field of vision. Candles, oil lamps, and ordinary coal gas can all be dealt with upon this principle. There are artificial lights, however—and in this category all the intense or high power light sources are comprised—which cannot be rendered unobjectionable by the method of subdivision. An electric arc lamp of about 1,000 candle power, naked, is the smallest that can be trusted to maintain itself with reasonable constancy. A Welsbach burner will not do the system justice when consuming less than 3½ cubic feet of gas per hour, and yielding an illuminating power of, say, about 55 candles. Whatever the illuminating power of an incandescent electric lamp, the filament must, from motives of economy, be kept at such a degree of brilliancy as to produce a painful effect of irradiation in the human eye, if regarded without a tempering screen of some kind. A recuperative gas lamp is nothing if the flame is not blindingly white hot.

Hence, for all these high power, intense lights there is nothing for it but a shading of some kind. But shading, as ordinarily effected, means simply obscuration and loss of light. A very thick opal or waved glass globe has to be used if the object is to render the dazzling point of light of the electric arc undistinguishable, and this entails a sacrifice of some 60 per cent. of lighting effect. The same remark applies to the Welsbach burner, as to which we do not hesitate to aver that any possibility of direct vision of the incandescent mantle is destructive of the claims of the light to be a pleasant one for any purpose. How objectionable the direct vision of the incandescent electric lamp filament is held to be by electricians, is sufficiently proved by the various attempts that have been made to get over the difficulty without saddling the already costly light with an additional cause of expense.

It seems verging on the absurd to have to continue the argument with a reference to the possibility of cutting or pressing the surfaces of clear glass globes into a system of lenses capable of reflecting and refracting light; for, as all the world knows, this was done by Fresnel for lighthouse purposes a very long time ago. Yet, strange as it may seem, success in producing at a reasonable price a globe for ordinary or intense lights, suitable for general use in interiors, and embodying the true principles of so reflecting and refracting the light as to render the source invisible while diffusing and distributing most of the rays to the best advantage, has been reserved for the present day, and for Messrs. Blondel and Psaroudaki. This invention, which we have had an opportunity of seeing exhibited at the office of Mr. S. M. Scott, the Manager for England, at No. 35 Queen Victoria street, E. C., is the "holophane" globe, briefly described in a "Note" in the *Journal* for March 12. Unless something unforeseen happens to spoil their prospects, Messrs. Blondel and Psaroudaki bid fair to remove, by their ingenious invention, the chief obstacle to the complete popularity of all commercial high power lamps and light sources of high intensity and small surface. There are no illustrations available as yet whereby we might show the holophane globe in operation; but we can testify to the fact that it has the appearance, when inclosing an incandescent gas or electric lamp, of a vase filled with light, brilliant yet soft. The actual burner or filament cannot be discerned. The desideratum of the advocates of diffusion in lighting is thus in effect supplied, although the source of light is a mere line or spot. We are assured that it is the same with the electric arc light. As for the loss entailed by all this reflection and refraction, it is certified by M. de Nesville to amount in the case of an arc light to from 9 to 13 per cent. As this observer remarks, there is no other kind of globe in existence capable of realizing such a diffusion of light, and at the same time presenting such a uniformity of effect. Seeing that the loss of light by transmission through clear glass is 8 to 10 per cent., the claim for the holophane globes that they do their special work for about 4 per cent. of loss is well established.

The principle of the holophane moulding is soon explained. The interior surface of the globe is formed into vertical grooves, which are so shaped as to spread out horizontally the rays proceeding from every part of the light source. They are thus moulded to one regular section. The mouldings on the outer surface of the globe are horizontal, and have the effect of distributing the emergent rays in the vertical sense; and inasmuch as the light may be required in some instances to be cast downward, and in others to be equally dispersed, the angles of the outside grooves are modified accordingly. This is a very different thing from the unscientific cutting seen in ornamental cut glass globes, which does nothing for the diffusion of the light. The holophane globes are manufactured in all sizes and in many shapes, such as spheres, tulips, cones, etc.; but the effect produced is always the same. Colored glass can, of course, be had if desired.

Mr. Blondel, one of the inventors of the system, is a well-known Consulting Engineer of the French lighthouse service. To him the calculation and working out of the lens mouldings appears to be due, while his colleague, M. Psaroudaki, of the Athens University, has devised the means whereby the globes can be made of cheap pressed glass, instead of requiring to be cut, like lighthouse lenses, which would, of course, have made them prohibitively dear. As remarked on a former occasion, the globes are patronized by the Paris Gas Company, and we venture to predict that, when once placed upon the English market on reasonable terms, they will be general favorites for all systems of lighting.

Superheating.

Mr. W. H. Booth, in a communication on this subject to the *Electrical Review* (London) remarks that were it attempted to explain the economy of superheating as due to the large amount of heat introduced

to the cylinder, the attempt would prove an utter failure, yet superheating will give an economy of 20 to 30 per cent. in steam consumption, which is singularly near to the 20 to 30 per cent. of initial condensation that is suffered by saturated steam entering the cylinder. To understand the action of superheating and to realize that it is not to the quantity of extra heat in the steam that the economy is directly due, let a pound of steam be taken and its behavior traced through the cylinder. The pressure shall be taken as about 100 pounds on the gauge. The temperature of such steam is 338° F., and its latent heat is 875 units. Admitted into a cylinder, one-fourth of this pound of steam condenses, and by the time the cylinder, by which will be understood, of course, the inner surface film of metal which changes temperature, has attained a temperature of 338°, there will be present in the cylinder three-quarters of a pound of steam at 338° and one-quarter pound of water at 338°, while the cylinder has absorbed the 219 units of heat set free by the liquefaction of this quarter pound. If the specific heat of steam be taken as 480, then to furnish 219 units of heat by means of superheated steam will call for 219 ÷ .480 or 456° of temperature. Hence the total temperature to heat the cylinder to 338° would be 794°, or the steam would be rapidly approaching a red heat, yet it would start on its duty of expansion at only 338°, and saturated, for all its superheat would be absorbed by the cylinder.

Neglecting for the moment any condensation due to conversion of heat into work, and assuming that dry exhaust steam abstracts no heat from the cylinder, and it would follow that the sudden admission of steam superheated to 794° would cause a dry exhaust and leave the cylinder as hot as the saturated steam previously employed, namely, 338°, and if only saturated steam were employed at the next stroke, none of it would condense, and there could be no cooling of the cylinder by re-evaporative effects. If this position be reasoned out it will be found that, still adhering to the two false assumptions named, any small degree of superheat would prevent condensation, its effect continuing from stroke to stroke. Thus the half of the above 219 units might be supposed to be added at one stroke; this would halve the condensation and halve the subsequent re-evaporation, and the cylinder would only be cooled to one-half its previous extent when using saturated steam. Then, upon a second stroke, and still adding the same superheat, the cylinder would attain steam temperature without causing condensation, and, after this point, the exhaust would be superheated, and so the addition of any fractional amount $= \frac{1}{x}$ of the whole missing heat would, in x strokes, produce dryness. But in practice there are to be dealt with (*a*) the loss of heat by conversion to work; (*b*) the absorption of heat by the exhaust even when this is dry.

In an engine working with 16¼ lbs. of steam per horse power hour, and expanding to half an atmosphere final pressure 1 lb. of steam will perform obviously 120,000 foot pounds of work, and to do this there must disappear 155 heat units. As the total heat of a pound of steam at half an atmosphere or 180°, and 338° only differs by about 48 units, the remaining 107 units must come from latent heat, and the value of the latent heat of steam at 180° is 988 units. Approximately .1083 of the steam thus disappears in the performance of work. More heat disappears in re-evaporating the steam thus condensed; this last heat comes out of the cylinder, which must, therefore, supply 107 units per pound of steam used, apart from anything further it may radiate to the exhaust. Probably this latter will be but small in amount; if, therefore, the initial steam be superheated to the extent of 107 units, or, say, to 223° F., it will be in a position to furnish all the heat necessary for the performance of work without any initial condensation; for, no steam being condensed during expansion, the cylinder will exert no re-evaporative effects and will, apart from radiation losses, be at full temperature to receive initial steam. The necessary temperature for the case in point is thus 338° + 223°, or 561°. But even this temperature may be excessive, and the figures simply show that, where superheaters are used, the steam is, nevertheless, always in a saturated condition in the cylinder, and they point further to the fact that the jacket and superheater may, where the mechanical conditions as to speed justify the practice, be combined in one engine, the superheater alone being insufficient to supply the heat required to produce dryness. How, it may be asked, are the 20 and 30 per cents. of economy realized that Prof. Unwin considers the Alsatian experiments to show? Very simply, indeed. There is a vast difference between condensation by cylinder action and condensation by performance of work. In the first case the water is all formed on the cylinder surfaces; it adheres to these until boiled off, when the pressure falls. In the second case water is formed throughout the body of the steam as this expands with performance of work, and some of this water never touches the cylinder, nor does it receive sufficient heat by radiation from the cylinder to re-evaporate it; it passes as water to the condenser and carries no latent heat with it. In place of the nominal amount of 223° of superheat being necessary, something very much less may be, and no doubt is, quite sufficient to realize all the economy claimed for superheating, and this will be the case preferably in such engines as have a very short stroke duration.

The conclusion to be drawn would appear to be in favor of a moderate though decidedly pronounced degree of superheating combined in slow moving engines with the jacket. When, however, the exhaust from the last cylinder begins to show any superheat—a doubtful possibility—then the additions of heat to the working fluid have gone past the limits of economy, probably to a considerable degree, for some mistiness of the exhaust would appear justifiable if due to work effects. So far as any tests yet published may be taken to show the average performance of the McPhail design of superheater, they show that it is scarcely to be designated as other than an efficient steam dryer and an excellent additional heating surface and preventer of priming. This follows naturally on the system employed of passing the steam pipe through the water space, and may be taken to show that this latter is overdone, and that all the steam should not be so treated, merely so much as may be found requisite to reduce the overheated condition of the portion taken direct from the superheated tubes to the engine. In most cases in practice of ordinary engines it is very unlikely that there is really absolute dryness secured by superheating. Such degrees of superheat as have yet been dared are not enough to do more than reduce initial condensation, so that, after all, the working steam is still saturated.

The Lighting of the Brooklyn Bridge Cars.

The *Scientific American* says that the lighting of the cars of a cable road by electricity is a novelty and requires the use of some special apparatus. In the main, the plan adopted on the Brooklyn Bridge resembles the now familiar trolley system. A bare copper wire is suspended from poles and from the framework of the bridge. This wire is carefully insulated, the return is made through the rails in the usual way. The current is supplied from the power house in Brooklyn. It is led to the center of the bridge through a feeding cable, which there divides into two branches, one leading to each of the towers and there connecting with the overhead wire. The overhead wires are in turn connected together at intervals of 500 feet. The height of the wire above the car was regulated by the framework which extends over the three suspension spans. The distance that this framework clears the car only allowed the wire to be suspended 9 inches above the roof of the car. At first it was thought that a regular trolley with a short pole could be used but the rocking and swaying of the cars was so great in proportion to the distance of the car from the wire that it had to be abandoned. Springs were used to allow the trolley a certain amount of play, but this was not enough to keep the wheel on the wire. A roller was then substituted for the wheel. This roller is made 18 inches long and is mounted in two arms, with which the roller forms a triangle, the apex being attached to the hinge and spring. The length of the roller is really greater than is necessary, but it allows a safe margin and there is very little chance of it ever jumping the wire. In the daytime the roller is lowered to avoid unnecessary friction. When the lamps are to be lighted the trainman of each car pulls a lever at one end of the car which operates bell cranks and a connecting rod, which raises the roller into contact with the wire.

It has been found advantageous to have the roller trail, no matter in which direction the car may be going. On the Brooklyn Bridge the lighting trolley or roller is tripped and reversed automatically in the stations while the cars are being switched, by means of a rigid frame. The cars are all connected by wires, so that if the trolleys on all the cars but one should get out of order, that one would be sufficient to light the train. When the cars are being switched this system prevents the flickering of the lights. As in the bridge itself, there is a slip or expansion joint in three places to allow for the expansion and contraction caused by changes of temperature. Great care is taken to maintain an even tension on the line.

The former plan of lighting the cars was the kerosene lamp system, and the poorness of the illumination was the subject of considerable comment. The residents of New York and Brooklyn are pleased with the fine light given by the 12 incandescent lights with which each car is equipped, and are now asking why the same system cannot be applied to the extensive elevated railroad systems of both cities. The subject of lighting cars in cities is now receiving great attention, and the results obtained on the Brooklyn Bridge and on the Broadway and Third avenue cable roads, which are lighted with gas, show that both gas and electricity are admirably adapted to city car lighting, without reference to the motive power employed.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

MR. FRED. W. FREESE informs us that the plant of the Albion (Mich.) Gas and Coke Company will be completed by June 1st. The works will be of the coal gas type. Mr. Freese intends to give his entire attention to the Albion plant, which will be unpleasant news for his former associates at La Porte, Ind., the gas works at which point were for quite a period under his energetic supervision.

MR. C. T. FROST, formerly at Summit, N. J., is now in charge of the works of the Citizens Gas Light Company, of Quincy, Mass.

MANAGER RUNNER, of the Freeport (Ills.) Light and Fuel Company, has arranged for important betterments on the gas division of that enterprise. One contract calls for the construction of a gasholder rated to contain 30,000 cubic feet, and the contractors are the Kerr Murray Manufacturing Company, of Fort Wayne, Ind. Another contract is that entered into with Mr. Fred. Bredel, of Milwaukee, Wis., who is to erect a scrubbing, condensing and washing apparatus, rated to pass 250,000 cubic feet per day. The third in the series of improvements covers a notable extension to the main system. The holder will be located on a site recently purchased, and the scrubbing machine is to be housed in the brick building of the old electric lighting station.

MESSRS. HUMPHREYS & GLASGOW have just contracted with two of the English Corporation gas works to furnish them with water gas plants. Southport takes a complete plant of a capacity of 750,000 cubic feet per day, and Manchester a complete plant of 3,000,000 cubic feet capacity per day. Including plant completed and that under contract, the total capacity of this form of water gas apparatus in Europe now foots up to about 35,000,000 cubic feet per day.

WE are indebted to Mr. George T. Thompson, of St. Louis, Mo., under date of the 1st inst., for the following: "On the morning of April 26th, at his home in St. Louis, occurred the death of Mr. Chas. Sillito, night Superintendent of Station B, of the Laclede Gas Light Company, and one of its oldest employees. To within four days of his death, which resulted from *la grippe*, he was actively engaged in his duties at the plant, although for some weeks he had been perceptibly failing. His connection with the gas business began in 1853, near Stoke-on-Trent, England. Coming to this country in the early sixties, he spent nearly 10 years with the Cincinnati Gas Light and Coke Company, leaving there in 1873 to take charge of the retort house of the Laclede Gas Light Company, in St. Louis, then just being completed. For the past 11 years he had charge of this latter plant at night, his death terminating a service of 22 years with this Company, and of 42 years in the gas business. The funeral was largely attended, the services at the residence being conducted by Rev. J. P. T. Ingraham, and those at the grave, in Bellefontaine Cemetery, by the officers of Anvil Lodge, No. 75, A. O. U. W., of which he had been an active member."

MR. RICHARD A. KEYES, of Salt Lake City, Utah, has been granted a franchise, for the period of 25 years, to supply the town of Farmington with either natural or artificial gas. This place is the capital of Davis county, and is on the Utah Central Railroad, at a point about 15 miles from Salt Lake City. It has some manufacturing establishments and is a fairly busy center, but its population cannot exceed 2,000.

THE following is the full text of the Illinois legislative measure proposing "to regulate the granting of franchises and special privileges by cities, villages and incorporated towns" of that State: "Be it enacted by the people of the State of Illinois, represented in the General Assembly, that the City Council in cities, the President and Board of Trustees in villages and incorporated towns, shall have no power to grant to any person or corporation a franchise authorizing the laying of gas pipes for the distribution of inflammable gas for fuel or lighting purposes, or to lay in or on the ground or string on poles any wires on, over or by which electricity for lighting purposes is to be used, conveyed or distributed in any street, alley or public grounds in any such city, village or incorporated town, except upon the petition of the owners of the land representing more than one-half of the frontage on the street or alley of any block along which it is proposed to lay such pipes or wires, or string such wires, and when the street or alley, or part thereof, sought to be used shall be continuous for more than one block, no petition of land owners shall be valid unless the same shall be signed by the owners of the land representing more than one-half of the frontage of each block of such street, or the part thereof wherein it is sought to lay such pipes or wires, or string such wires."

MR. S. F. CLARK has been appointed Superintendent of the Middletown (Conn.) Gas Light Company, vice Mr. John F. Jones, resigned. Mr. Joseph Harvey is to act as Asst. Superintendent.

THE following are some of the main provisions of the ordinance granting the right to the proprietors of the Asbury Park (N. J.) Gas Company to carry on business in that place. The new Company is to succeed to the privileges heretofore owned by Messrs. Jas. W. Hodge Chas. H. Fletcher and George H. Fletcher, which privileges are about to expire by limitation:

"5. And be it enacted, that the said Asbury Park Gas Company agrees to furnish to the inhabitants of said borough of Asbury Park gas of superior quality of not less than 20 sperm candle power, 5-foot burners, and of a rate not to exceed $2 per 1,000 cubic feet, and shall furnish gas for heating and cooking purposes at a rate not to exceed $1.60 per 1,000 cubic feet. Said Gas Company shall furnish to the borough of Asbury Park, for public use, 50,000 cubic feet of gas per year, free of cost, and for all gas used by said borough in excess of 50,000 cubic feet, the said borough shall pay at the rate of $1.50 per 1,000 cubic feet. Provided, however, that nothing in this ordinance shall be construed as an agreement on the part of the Mayor and Council to take any gas whatever for public purposes. On the 1st days of April and October of each year the Finance Committee of the Mayor and Council shall have the privilege to examine the meter books to ascertain the average annual consumption of gas for the year.

"6. And be it enacted, that this franchise is granted upon the further express condition that when the consumption of gas at Asbury Park shall reach the average consumption of 40,000 cubic feet per day, then the price at which gas shall be furnished to the inhabitants and the borough shall not exceed a sum equal to the said above mentioned prices, with a deduction of five (5) per cent. therefrom, and when the said consumption of gas shall reach an average consumption of 50,000 cubic feet per day throughout the year, the same shall be furnished at $1.80 per 1,000 cubic feet for illuminating and $1.50 for heating and cooking purposes; and when the said consumption shall reach an average of 60,000 cubic feet per day, the same shall be furnished at $1.70 per 1,000 for illuminating and $1.40 for heating and cooking purposes; and when the said consumption shall reach an average of 75,000 cubic feet per day, the same shall be furnished at $1.60 per 1,000 for illuminating and $1.35 for heating and cooking purposes; and when the said consumption shall reach an average of 100,000 cubic feet per day, the same shall be furnished thereafter at $1.50 per 1,000 for illuminating and $1.25 per 1,000 for heating and cooking purposes."

THE new machine shop for the Gould's Manufacturing Company, at Seneca Falls, N. Y., will be designed and built by the Berlin Iron Bridge Company, of East Berlin, Conn. The building as designed will be constructed with a steel frame, and its equipment will include a 15-ton crane.

AMONG the bills recently introduced in the Delaware Senate is one by Mr. Pyle which proposes to amend the charter of the Oxy-Hydrogen Gas Company. It renews the charter for a period of 20 years, and provides that in the laying of pipes in any city or town in the State it shall not have to get the consent of the authorities, their only duty being to supervise the work from an engineering point of view. This amendment will, if granted, allow the Oxy Hydrogen Company to open the streets of Wilmington and lay pipes therein despite the protest or objection of the civil authorities of that city. The amendment is in Sec. 1 of the charter. It inserts between the words "Delaware" and "and" the following: "Subject only to reasonable and proper engineering supervision respecting the location of said pipes."

SENATOR PYLE is responsible for the introduction of another gas bill in the Delaware Legislature. Its purpose is to give corporate life to the Brandywine Gas Company, of Delaware. The incorporators named are: J. Edward Addicks, Jas. G. Shair, Robert Hanby, John H. Bateman and J. F. Allee.

THE officers chosen to manage the Rhinebeck (N. Y.) Gas Company for the ensuing year are: President, John J. Williams; Secretary, R. Raymond; Treasurer, John McKinn.

THE Connecticut Legislature has passed the resolution extending the life of the charter of the Fairfield Gas and Electric Company.

THE proprietors of the Knox (Me.) Gas and Electric Company have determined to construct a new gasholder.

THE plans for the buildings to house the water gas station of the Springfield (Mass.) Gas Light Company are being prepared by Architect Kirkham. The structures are to be two in number, the generator house to have a dimension of 114 by 60 feet.

THE consolidation of the Natick (Mass.) Gas and Electric Company with the Eliot Falls Electric Company, of South Natick, is virtually completed. The Eliot Falls Company now has the contract for the public lighting of the adjoining boroughs of Wellesley and Needham.

AT a meeting of the Committee on Light of the Richmond (Va.) Council, held early this month, Mr. Caskie called up his resolution providing for the construction of a gasholder in the West End, and for the laying of certain additional mains recommended in that section of the city by Supt. Adams, of the city gas works. Mr. Starke explained that the Committee on Finance could not now provide the Committee with the $60,000 necessary for the entire improvement; but as he thought the sum of $16,000, to go on with the main laying, could be set aside, he moved that the Council be asked for this sum for that work. The motion was agreed to.

SEC. AND TREAS. ELLISON, of the St. Paul (Minn.) Gas Light Company has notified the shareholders that the regular quarterly dividend of 1½ for the past quarter is payable on demand. The transfer books will be reopened on the 15th inst.

PROF. J. C. LEACH, the present Inspector of Gas for Indiana, completed a partial tour of the natural gas belt of that State during the month of April, and he thus sums up the condition of the supply: "There are some sections of the gas field that I have not visited at all, and am, therefore, not sufficiently informed to give an intelligent estimate of the gas supply; but judging from what data I have at hand, I believe that the static pressure of the gas field is decreasing. True, there are some wells that show a very slight decrease, if any; but this is the exception and not the rule. The belief in many places that gas will last forever, and the extravagant use and waste caused thereby are doing great damage to the commercial interests of the gas field, for no one knows better than the manufacturer, who is looking for a location for a factory, that at the present rate of reckless wasting of this precious fuel, the time is not far distant when he will have to return to coal. The gas companies have realized this for some time, and are doing all they can to husband their supply, and I am glad to say that in some places the people are awakening to these facts—are doing what they can to create a sentiment against the waste of this fuel."

WE are informed that a project for the establishment of a gas works at Monroe, Wis., is mooted, and that Mr. Fred. Bredel is one of those concerned in the preliminaries; nor could a better man be behind the scheme. Monroe is the capital of Green county, Wis., is the terminus of a branch of the Chicago, Milwaukee and St. Paul Railroad, and is about central of Madison and Janesville. It sustains many and varied sorts of manufactures, and has a population of 5,000 or more. It looks that a scheme of this sort ought to be a go there.

DURING April the candle power of the gas furnished the city and people of Minneapolis by the Minneapolis Gas Company averaged 26.99, if the report of the City Gas Inspector (Mr. Meeds) is correct.

AT the annual meeting of the Cumberland (Md.) Gas Light Company the following officers were elected: Directors, Messrs. H. Swartzwelder, John McIlhenny, James Gardner, Robt. Shriver and Webster Bruce; President, H. Swartzwelder; Secretary and Treasurer, Van Lear Eastland.

MR. F. B. WHEELER, formerly in charge of the works of the Schenectady (N. Y.) Gas Company, proposes to engage in the business of consulting engineer. His headquarters will be in Schenectady.

WE regret to announce the retirement of Mr. P. O'Shea from the office of Superintendent of Lamps of the city of Boston, for he has been a model officer in every respect. The following excerpts are from his official report respecting the lighting of Boston for the past year:

"Owing to the reduction in the price paid for electricity, 827 new electric lights were established during the year and the amount of general work done by this department in erecting new posts and brackets for electric, gas, and naphtha lighting was nearly double that accomplished in any year since its organization. As a result, the main arteries of travel are now well lighted, as is also the business section of the city, from which there has been heretofore many complaints. All the gas lamps on Boston Common were removed and the entire area lighted by the underground electric system. There have also been 207 electric lights erected on the parks and parkways. There are also 45 lights on Castle Island and bridge and the Charlesbank gymnasium, on the overhead circuit, which are maintained by this department, with 28 incandescent lights, 14 of which are under bridges on the Parkway and 14 in the tunnel at Allston. The total number of gas lamps displaced was 1,700, on which account the force of employees was reduced by 18 men. There were erected 300 gas and naphtha lamps, mostly in the southern and growing section of the city. The plan followed by this department in the establishment of electric lights has been to place them on the more important thoroughfares, where the greatest service can be obtained from them, gas lamps, properly located, being more suitable for residential sections. Regarding gas lighting the following table shows the several companies who supply gas to the city, the candle power of the gas furnished, and the contract price paid for the same; the first five companies supply water gas, while coal gas is furnished by the other three:

	Per 1,000 Feet.	Candle Power. Average for Year.
Brookline Gas Light Company, for south part of city proper and part of Roxbury	$0.70	26.6
Brookline Gas Light Company, for Brighton	1.25	26.6
Boston Gas Light Company, for city proper	.90	24.6
Roxbury Gas Light Company, for Roxbury	1.08	21.1
Dorchester Gas Light Company, for Dorchester	1.17	24.8
South Boston Gas Light Company, for South Boston	1.17	23.2
Jamaica Plain Gas Light Company, for W. Roxbury	1.50	18.4
East Boston Gas Company, for East Boston	1.35	17.9
Charlestown Gas and Electric Co., for Charlestown	1.25	18.7

There are 7,440 public gas lamps in service and are fitted with an automatic regulator glycerine burner, consuming 4 feet of gas each per hour. Of naphtha lamps there were in use 2,709, lighted by the Rising Sun Street Lighting Company, under contract, at $21 per lamp per year. These are located mostly in the suburban districts where there are no gas mains or other means of lighting. The electric lights, 2,358 in number, located in the different sections of the city, are arc lights of what is commercially known as 2,000-candle power. They are cared for by men employed by the different companies. The underground work done by the lamp and park departments during the year was as follows: Laid on Boston Common, 14,970 feet of cable in wrought iron pipes or ducts, and 48 lamps were connected therewith. In a similar manner on the parks and parkways, as follows: Commonwealth avenue, 15,676 feet, 39 lamps; Back Bay Fens, 17,361 feet, 45 lamps; River Way and Leverett Park, 20,168 feet, 50 lamps; Jamaica Way, 14,365 feet, 34 lamps; Franklin Park, 13,865 feet, 35 lamps; and Marine Park, 2,683 feet, 4 lamps—a total of 99,088 feet of cable and 255 lamps. All the lamp posts on the Common and on the parks and parkways, together with the underground cable therefor, are city property. The cost of maintenance of electric lighting in 1894 was $243,670.61, as against $225,776.82 in 1893; and of gas and naphtha lighting $282,078.69, as against $321,845.96 for the preceding year. The total number of new lamps of all kinds set up in 1894 was 1,291, and eight fire alarm box lamps. The total amount expended was $573,110.52, leaving a balance of $9,389.48 unexpended appropriation."

THE following nervy communication to the members of the Light Committee of the Board of Aldermen of Montreal explains itself:

"Gentlemen—I beg leave to intimate that I arrived in Montreal this morning [May 3d] and represent the Whessoe Foundry Company, Limited, of Darlington, England, gas plant manufacturers, for the purpose of submitting a proposal on their behalf for supplying a complete gas works to the city, on terms of which the following are the leading features: The contractors will supply and erect the whole of the necessary works and lay 110 miles of main and all appurtenances of sufficient capacity for the present requirements of the city of Montreal for the sum of $1,500,000, to be paid to them in city bonds, redeemable at the end of 40 years, bearing interest at 4 per cent., and issued at par. They will guarantee that the cost of the gas into the consumer's meter shall not exceed 60 cents per 1,000 cubic feet, and shall not be less than 24-candle power. They will be prepared to make any such deposit as the city may require for the assurance of the fulfilment of their part of the contract and their guarantee of the results. With entirely new city works the gas will cost, delivered to the consumer's meter, 43 cents per 1,000 cubic feet, to which must be added the annual cost per 1,000 for interest on $1,500,000 of bonds, and the sinking fund to redeem the same in 40 years. The amounts required for this are $60,000 for interest, $15,750 for the sinking fund; total, $75,750. The quantity of gas sold in the financial year of the present Gas Company, ending April, 1893, was 459,535,000 cubic feet. Dividing the $75,750 by this number of cubic feet, you will see that 17 cents per 1,000 of gas sold is sufficient to pay the interest and sinking fund. The cost, as previously stated, being 43 cents per 1,000, it follows that the corporation could supply gas of 24-candle power to the consumers at 60 cents per 1,000 cubic feet without making a loss, and thus save to the citizens the whole difference between 60 cents and the price charged by the Company. I shall be pleased to submit further details, if desired, and meanwhile beg to refer you to the Canadian Bank of Commerce, of Montreal, for any information you may wish as to my Company's means and facilities for carrying out such a contract. I remain gentlemen, your obedient servant, H. S. KING."

THE AMERICAN GAS LIGHT JOURNAL

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PROPRIETORS.

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MONDAY, MAY 13, 1895.

The Market for Gas Securities.

Continued strength, in fact to the point of buoyancy, marked the trading in city gas shares during the week. Consolidated sold up to 143¾ on Tuesday, but since then a slight reaction occurred. To-day (Friday) sales were made before noon at 142⅞ to 143. The stock looks to us to be good for 150 before high-water mark is reached. Equitable is actually buoyant, and although we quote it at 196, bid, we imagine that holders would have no trouble in getting 200 for it. Mutual is wanted at 163. East Rivers are also in the ascending scale, with 27½ freely bid for the common. Standard preferred is virtually at par, and the common is 48 bid. Brooklyn shares are dull, with no changes of moment in the quotations; nor is there likely to be any alteration in values there, unless the changes are on the lower scale.

Chicago gas is strong to-day, at 75, and there is good evidence that a policy of conservatism is hereafter to rule in the Company's management. Now that Mr. Addicks' senatorship chance is out of sight, it is likely he will have hours in the daytime to devote to the gas business. In that event look out for moves and mates in Bay States. Consolidated, of Baltimore, is strong, and Lacledes maintain their advance. A notably strong stock is Western, of Milwaukee, and there can be no doubt that it is a purchase, even at ruling figures.

Gas Stocks.

Quotations by Close & Nash, Brokers and Dealers in Gas Stocks.
35 WALL ST., NEW YORK CITY.

MAY 13.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,430,000	100	142⅞	143
Central	500,000	50	140	..
" Scrip	220,000	..	100	..
Equitable	4,000,000	100	196	..
Bonds, 6's	1,000,000	1,000	105	107½
" 1st Con. 5's	2,300,000	1,000	111	112
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	163	..
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	..	..	..
Northern	150,000	50	..	..
" Bonds	150,000	..	..	98
New York and East River	5,000,000	100	27½	29½
Preferred	2,000,000	100	45½	47½
Bonds	3,500,000	1,000	85	86
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	..	..	..
Standard	5,000,000	100	48	50
Preferred	5,000,000	100	99	..
Bonds, 1st Mortgage, 5's	1,500,000	..	104	..
Yonkers	.....	50	101x	.
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	125	..
Citizens	1,200,000	20	65	..
" S. F. Bonds	330,000	1,000	..	101
Equity	2,000,000	10	..	..
" Bonds	1,000,000	..	..	..
Fulton-Municipal	3,000,000	100	175	..
" Bonds	300,000	..	103	..
Peoples	1,000,000	10	90	.
" Bonds, 7's	308,000	..	100	..
" " 6's	94,000	..	98	100
Metropolitan	870,000	100	170	..
" Bonds, 5's	70,000	..	..	..
Nassau	1,000,000	25	200	..
" Ctfs.	700,000	1,000	99	100
Williamsburgh	1,000,000	50	200	..
" Bonds	1,000,000	..	107	110
Out-of-Town Companies.				
Bay State	5,000,000	15	21¾	23½
" Income Bonds	2,000,000	1,000	31	35
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	..	78½
2d " " "	3,000,000	1,000	..	57½
Buffalo Mutual	750,000	100	120	..
" Bonds	200,000	1,000	95	100
Chicago Gas Co.	25,000,000	100	75	75⅛
Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds	7,650,000	1,000	93	93½
Columbus	1,069,000	..	..	..
1st Mortgage	1,085,000	..	..	..
Consumers, Jersey City	2,000,000	100	72	75
" Bonds	600,000	1,000	97	99
Cincinnati G. & C. Co.	7,000,000	100	..	203¾
Consumers, Toronto	1,600,000	50	184½	187
Central, San Francisco	.....	..	90	100
Capital, Sacramento	.....	..	..	50
Consolidated, Baltimore	11,000,000	100	63⅝	64½
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,400,000	..	..	..
Detroit	4,000,000	..	20	..
" Con. Bonds	4,312,000	..	..	..
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	74½	76
" Bonds	2,000,000	..	82	84
Hartford	750,000	25	120	128
Indianapolis	2,000,000	..	140	145
" Bonds, 6's	2,650,000	..	102	..
Jersey City	750,000	20	195	..
Lafayette Gas Co., Ind.	1,000,000	100	85½	87x
Bonds	1,000,000	1,000	85	88
Louisville	2,570,000	50	..	130
Laclede, St. Louis	7,500,000	100	28½	29
Preferred	2,500,000	100	86	87
Bonds	9,034,400	1,000	96	98
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	208
New Haven	.....	25	200	..
Oakland, Cal.	.....	..	43⅝	43¾
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	2,100,000	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	165	175
Paterson, N. J.	.....	25	99	102
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	81	..
Consolidated 5's	2,000,000	..	87½	90
Syracuse, N. Y.	500,000	25	..	..
San Francisco, Cal.	10,000,000	100	72¾	73¼
Washington, D. C.	2,000,000	20	250	..
Western, Milwaukee	4,000,000	100	55	58
Bonds, 5's	3,556,000	..	84½	86
Wilmington, Del.	500,000	50	188	190

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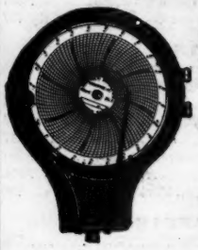

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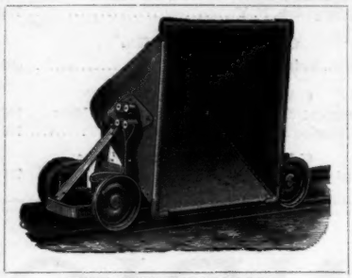

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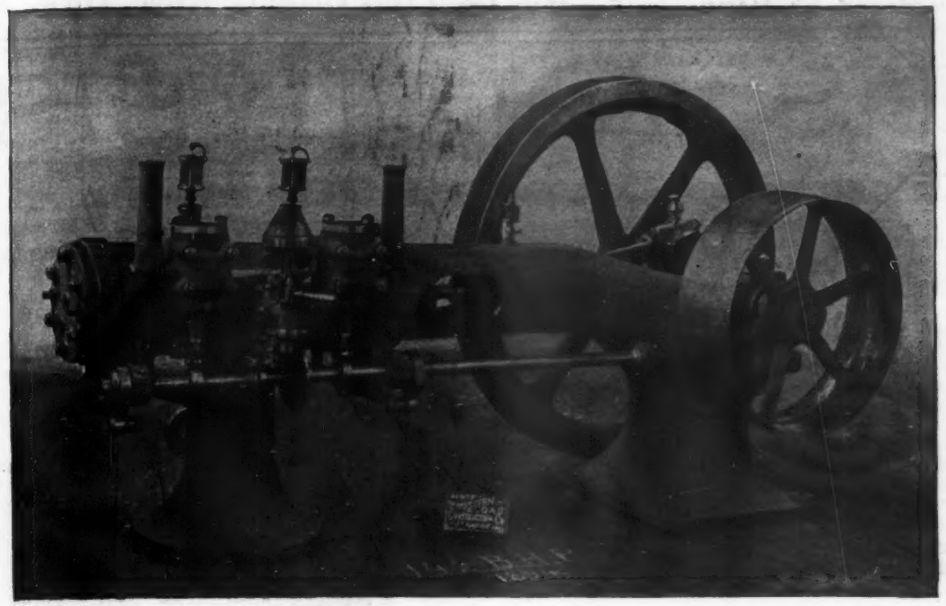

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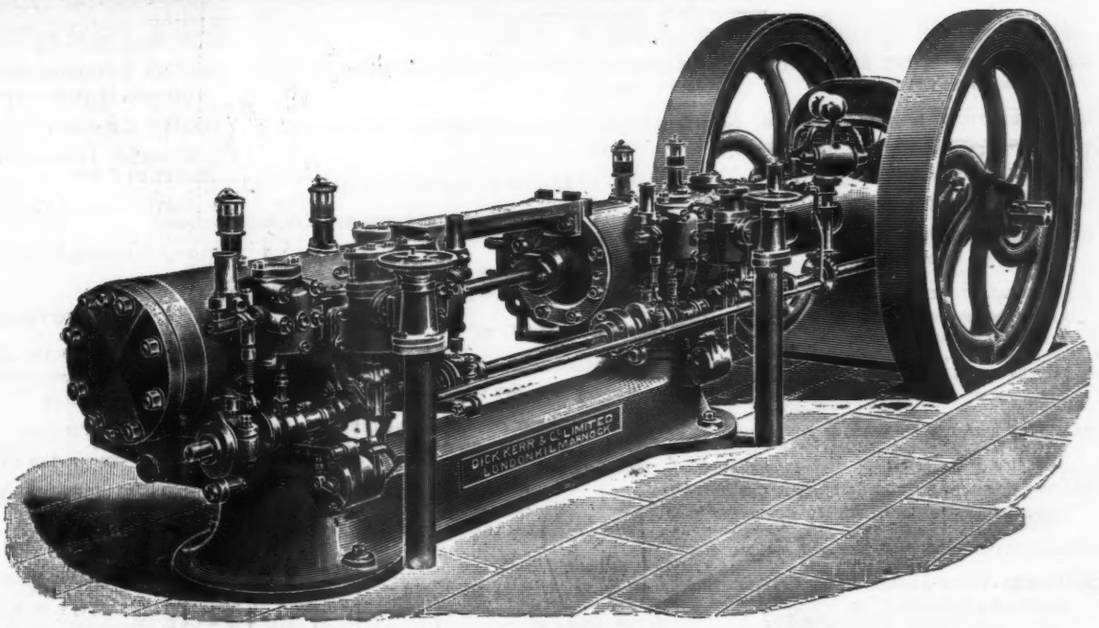

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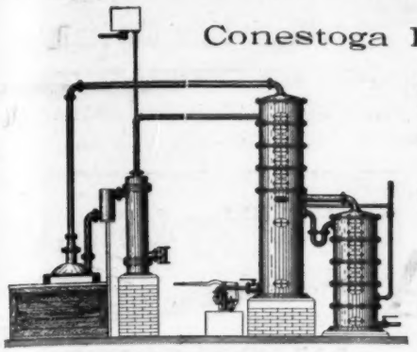

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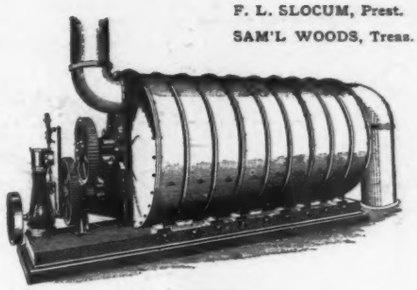

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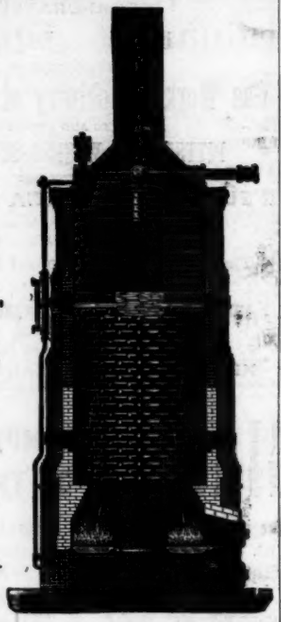

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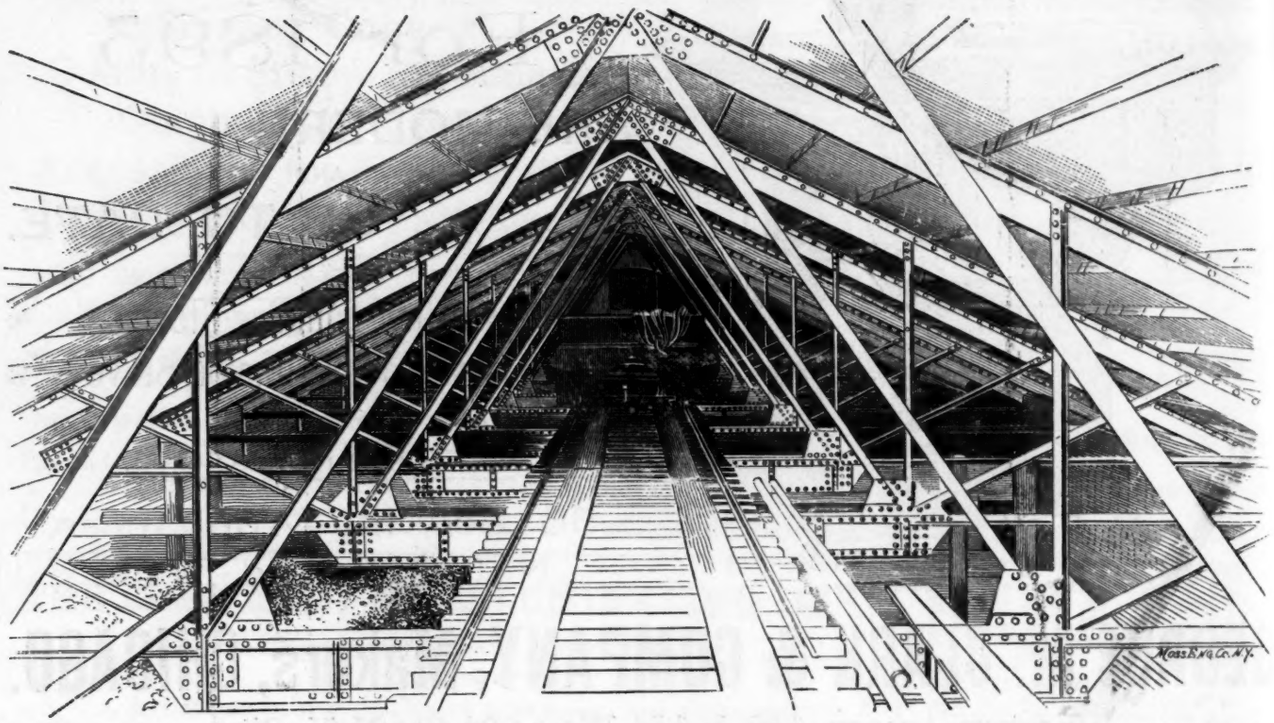

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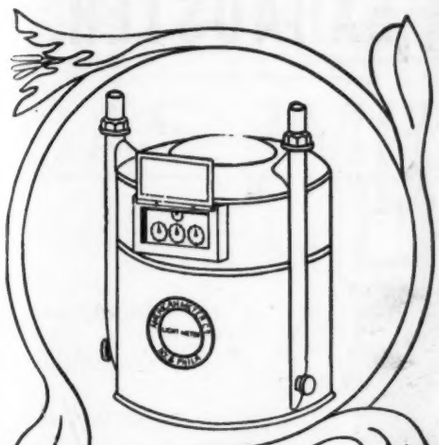

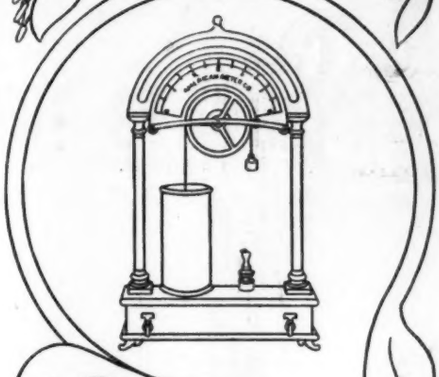

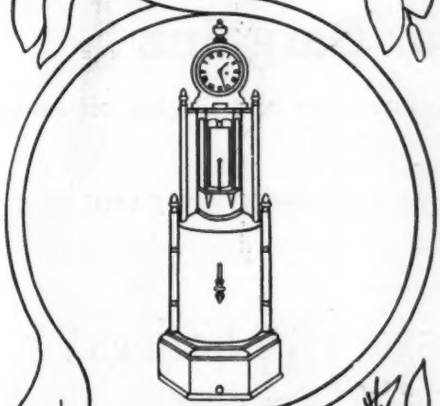

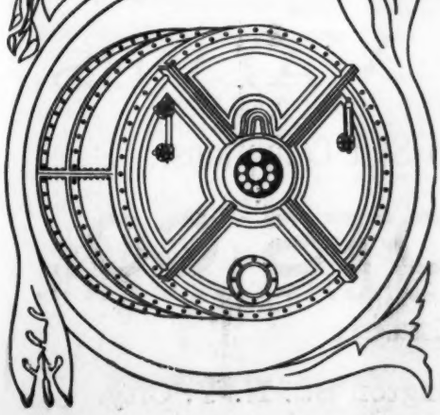

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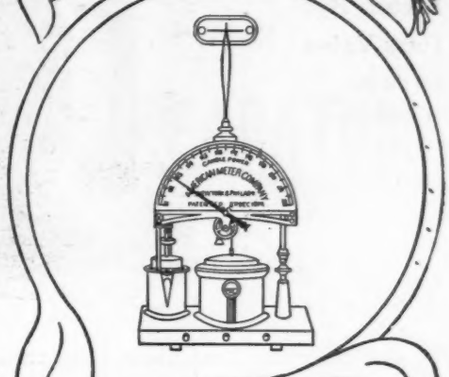
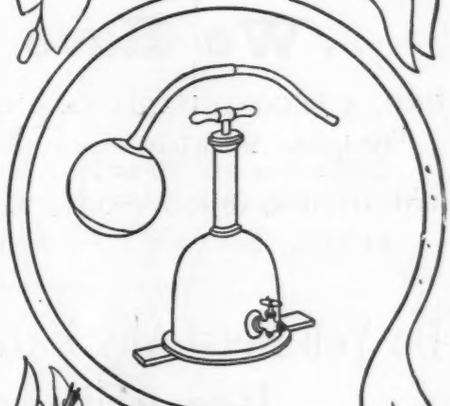
MAY, 1895.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Wed.	1	12.40 AM FQ	4.00 AM	6.45	4.00
Thu.	2	1.10	4.00	6.45	4.00
Fri.	3	1.30	4.00	6.45	4.00
Sat	4	2.00	4.00	6.45	4.00
Sun.	5	2.20	3.50	6.45	4.00
Mon.	6	2.50	3.50	6.45	4.00
Tue.	7	No L.	No L.	6.55	3.40
Wed.	8	No L. FM	No L.	6.55	3.40
Thu.	9	No L.	No L.	6.55	3.40
Fri.	10	7.30 PM	10.30 PM	6.55	3.40
Sat.	11	7.30	11.30	6.55	3.40
Sun.	12	7.40	12.20 AM	6.55	3.40
Mon.	13	7.40	1.00	6.55	3.40
Tue.	14	7.40	1.30	7.00	3.30
Wed.	15	7.40	2.00	7.00	3.30
Thu.	16	7.40 LQ	2.20	7.00	3.30
Fri.	17	7.40	2.40	7.00	3.30
Sat.	18	7.40	3.00	7.00	3.30
Sun.	19	7.40	3.20	7.00	3.30
Mon.	20	7.40	3.40	7.00	3.30
Tue.	21	7.40	3.40	7.10	3.15
Wed.	22	7.40	3.40	7.10	3.15
Thu.	23	7.40	3.40	7.10	3.15
Fri.	24	7.40 NM	3.40	7.10	3.15
Sat.	25	7.40	3.40	7.10	3.15
Sun.	26	7.50	3.30	7.10	3.15
Mon.	27	7.50	3.30	7.10	3.15
Tue.	28	7.50	3.30	7.15	3.15
Wed.	29	11.10	3.30	7.15	3.15
Thu.	30	11.40 FQ	3.30	7.15	3.15
Fri	31	12.00	3.30	7.15	3.15

TOTAL HOURS LIGHTING DURING 1895.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	237.00	January	423.20
February	196.40	February	355.25
March	195.50	March	355.35
April	165.30	April	298.50
May	153.40	May	264.50
June	138.20	June	234.25
July	146.30	July	243.45
August	152.50	August	280.25
September	165.10	September	321.15
October	186.10	October	374.30
November	204.10	November	401.40
December	219.30	December	433.45
Total, yr.	2161.20	Total, yr.	3987.45





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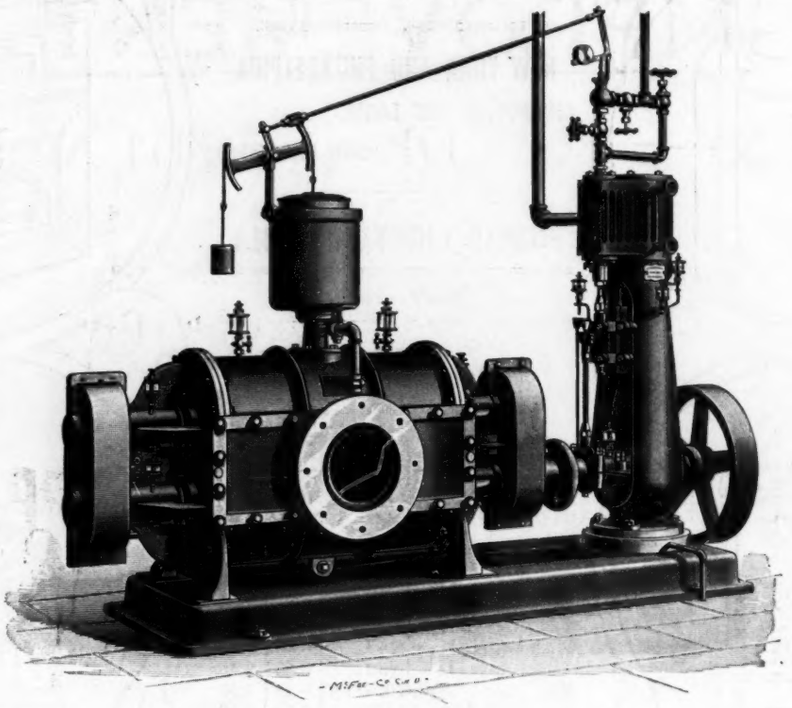

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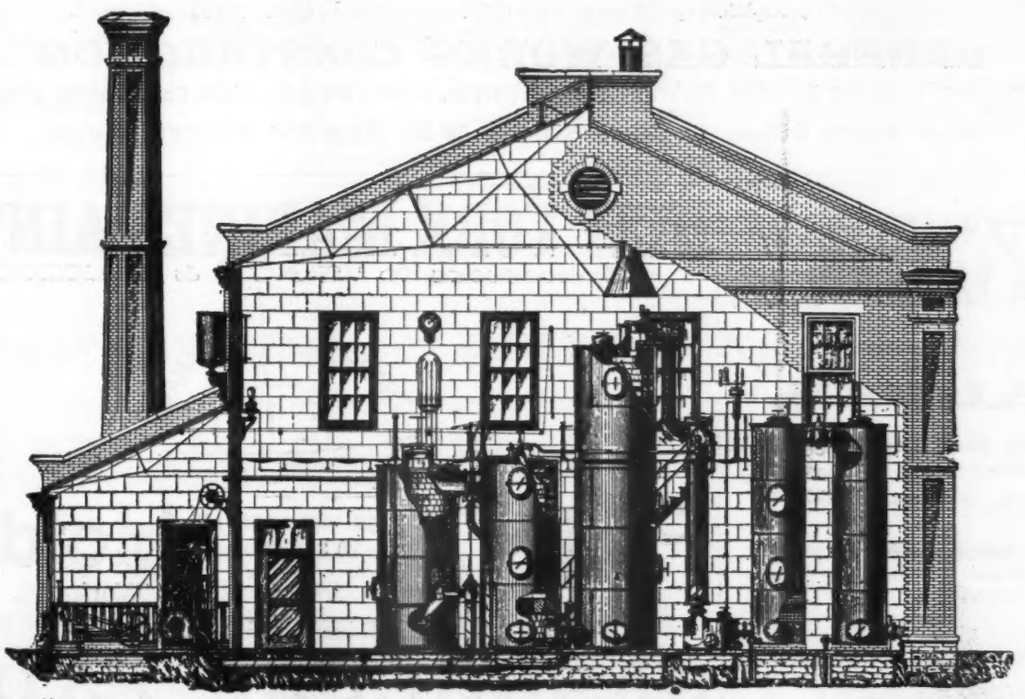

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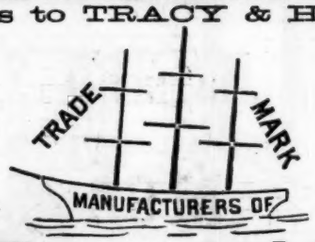

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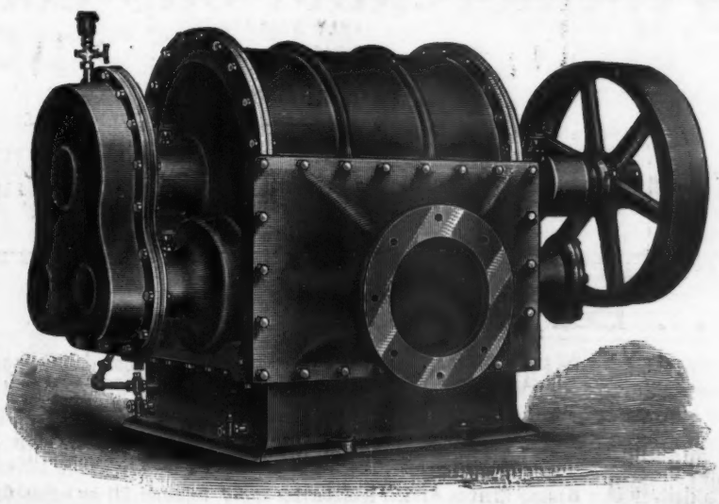

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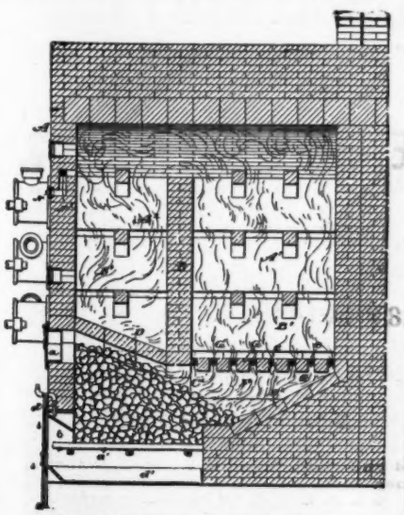

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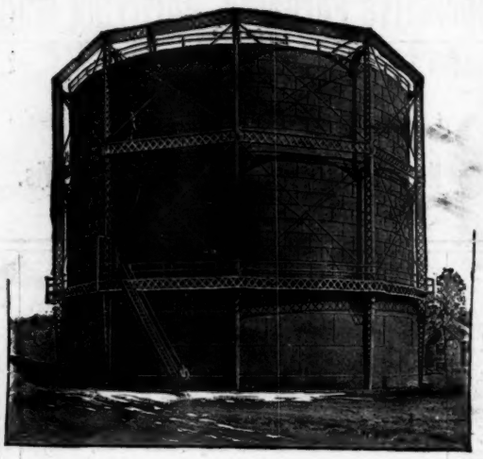

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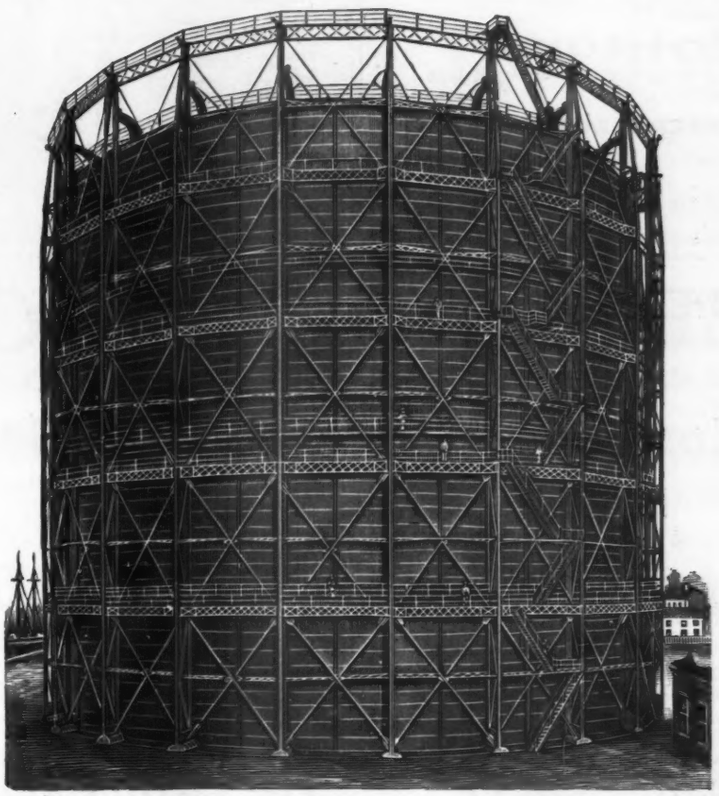

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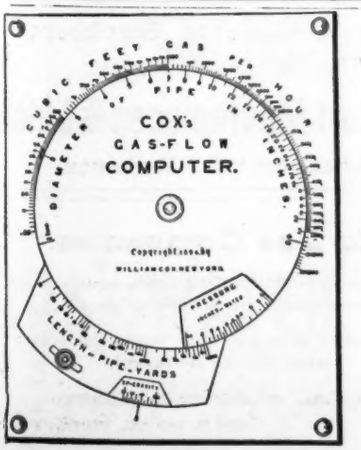

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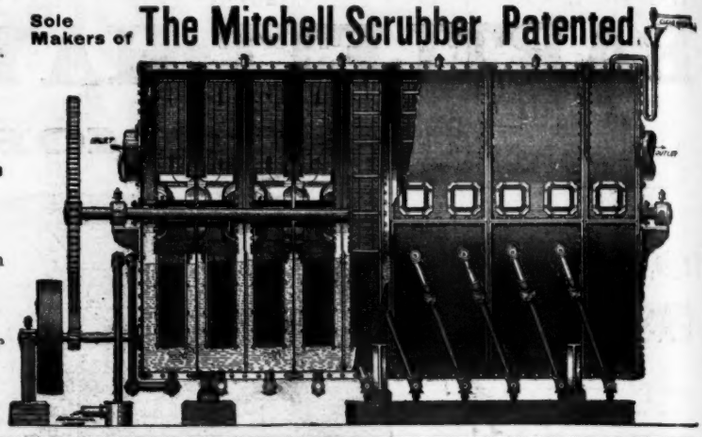

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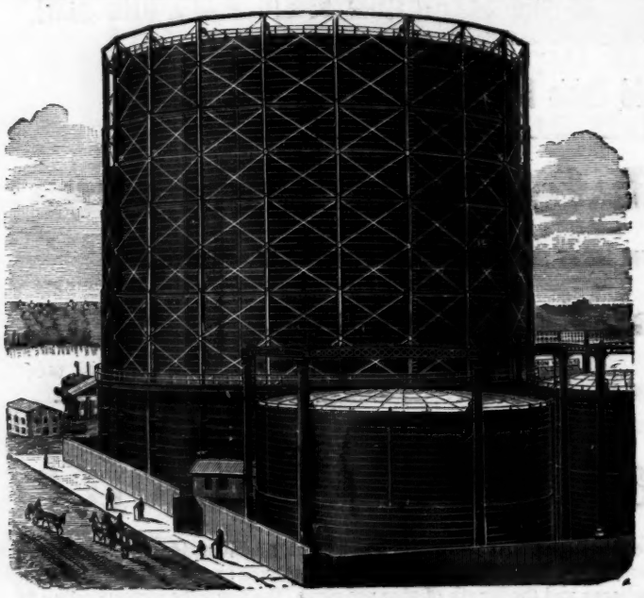

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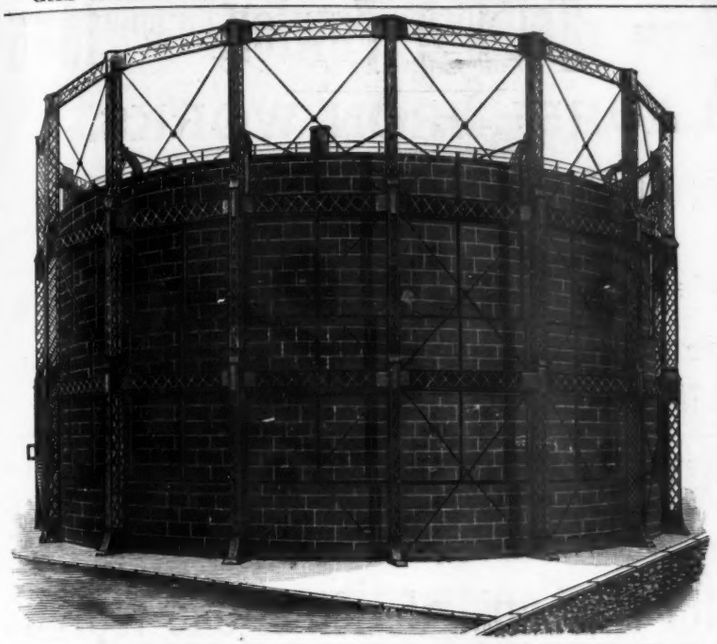

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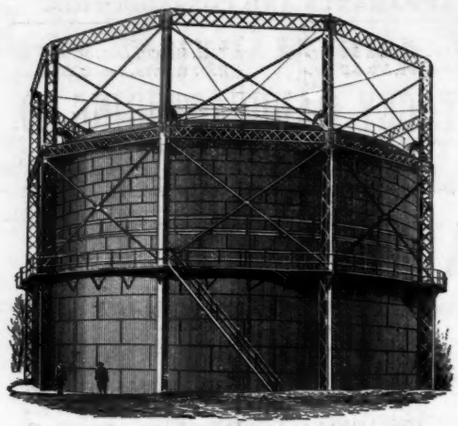

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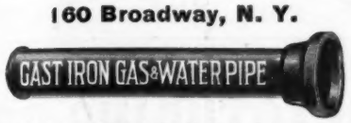

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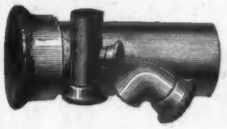

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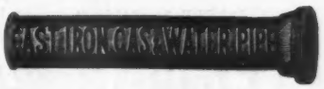

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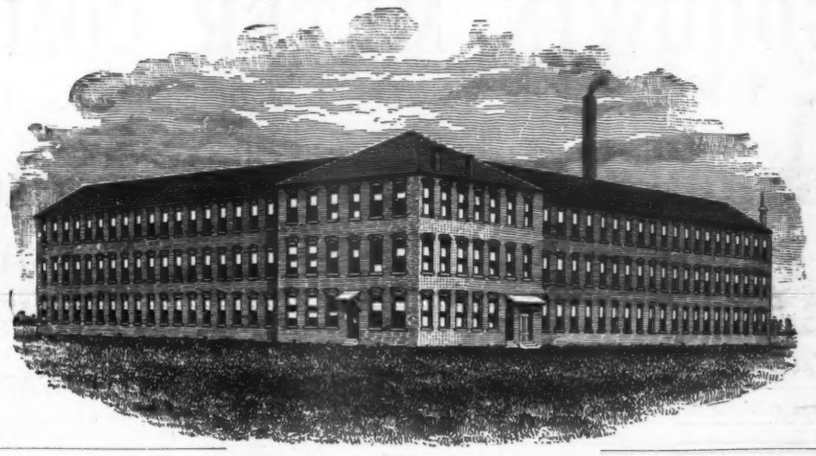

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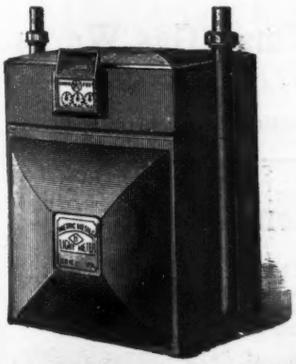

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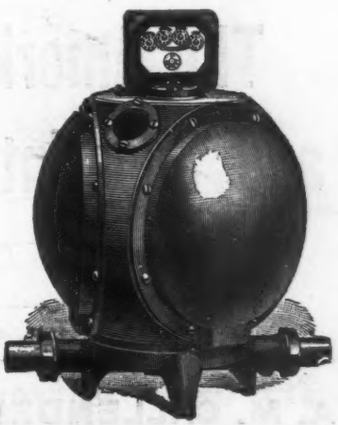

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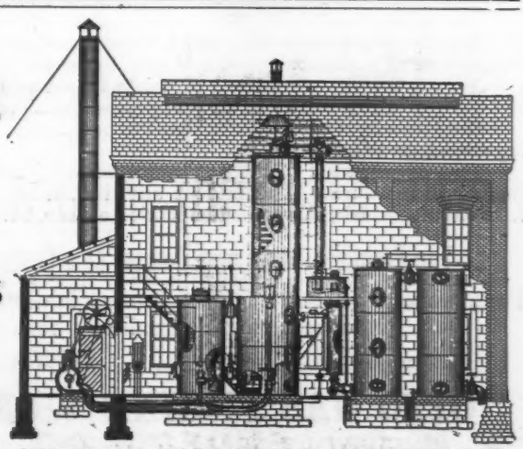

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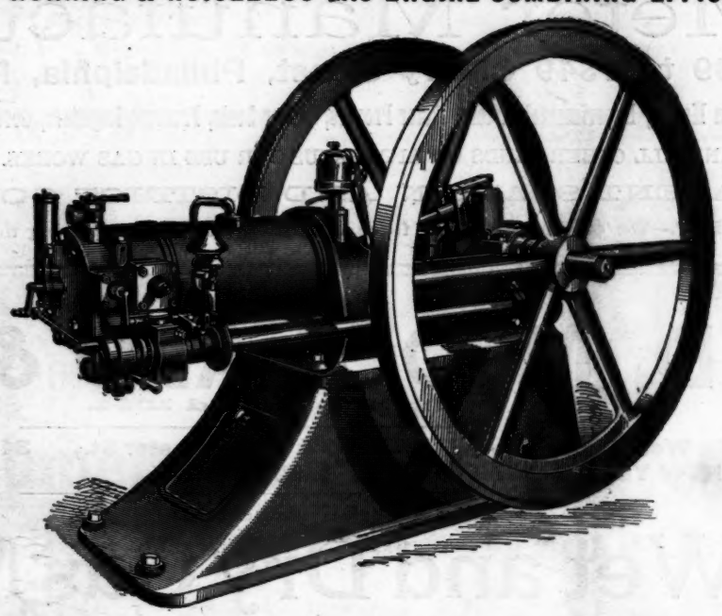

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